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THE AMERICAN JOURNAL OF ROENTGENOLOGY

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SOME ASPECTS OF SPECIAL INTEREST BEARING ON THE ROENTGENOLOGICAL DIAGNOSIS OF TUBERCULOSIS OF THE LUNGS*

BY HENRY HULST, A.M., M.D.

GRAND RAPIDS, MICH.

THE science of roentgenology is in the interpretation of the roentgenograms as applied to the diagnosis and prognosis of disease, just as the science of pathology lies in the interpretation of the slide" is the pronouncement of one who takes special pride in letting it be known that he is a specialist, that his specialty is that of roentgenology. He is a roentgenological diagnostician, therefore, of many medical and surgical specialties.

We have reached a stage in the evolution of roentgenology in which we look down condescendingly upon the art of making roentgenograms as no longer deserving, because it no longer requires the valuable time and personal effort of the physician. By a happy division of labor the technician relieves the roentgenologist of what formerly took much of the doctor's attention, the mere making of pictures, during the first period, in reality the premedical period, of roentgenology.

We have now entered upon the second period, the genuinely professional period. But I see a third period, the ultimate period, casting its shadow before.

As Cohn pointed out, "He will derive most assistance from roentgenology who has acquired the greatest proficiency in clinical and physical methods of examination," so also the specialist, the real specialist who devotes himself heart and soul to one branch only of medicine or surgery, should be best able to interpret roentgenograms pertaining to his particular specialty. This will constitute the period of "benevolent assimilation" of roentgenology, and of the roentgenologist, too, by medicine and surgery. The division of labor which resulted in the differentiation between technician and roentgenologist in the second period will go on logically, perhaps unmercifully, until every physician in the final period interprets his own plates.

But before this millennium is fully upon us, before the second-period-roentgenologist shall disappear from the face of the earth as an anachronistic, superfluous, moreover necessarily superficial and therefore more or less ridiculous middleman, and only physicians and technicians remain, I should like to remind you of two or three facts, lest we forget, and then consider some of

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the points of special interest just at present in connection with the roentgenological diagnosis of tuberculosis of the lungs.

Roentgenology of the lungs dates back to the very beginning of the use of the rays. Thus, Dr. Crane published in March, 1899, in the Philadelphia *Monthly Medical Journal*, his article on "Skiascopy of the Respiratory Organs," one of the earliest detailed presentations of the subject in this country. At this period the fluoroscope was chiefly relied upon and was more useful, without a doubt, than roentgenography, which was but poorly done. In 1899 but few roentgenologists could take a lung in one minute. More commonly five or ten minutes were required.

It was in this same year that Rieder and Rosenthal (*Muenchener medizinische Wochenschrift*, 1899, No. 32, and *Fortschr. a. d. Geb. der Roentgenstr.*, 1899, Vol. III) reported their method of making roentgenograms of the lungs in one second or less by sandwiching a film between two intensifying screens. This constituted not the beginning but the first great stride in advance in the roentgenology of the lungs. The beautiful atlas: "Die Roentgenographie in der inneren Medizin," by Prof. H. Von Ziemssen and Prof. H. Rieder, published by J. F. Bergmann in Wiesbaden in 1901, was the first fruit born of this conception. How I admired those pictures with their wealth of detail as compared with the meagre black and white gross shadow pictures of earlier days!

At the third Annual Meeting of the Am. Roentgen Ray Society in Chicago, Dec. 10 and 11, 1902, I was permitted to exhibit, though not yet a member, roentgenograms of the lungs taken in one, one half, and one fourth second, with and without the use of intensifying screens. These were the first of the kind made and exhibited in this country.

The next year I read by invitation of the Society at its Philadelphia meeting an article on "Skiagraphy of the Chest" which was published in the Transactions of the Society for 1903 together with a halftone reduction of the first one-second tuberculous chest without the use of intensifying screens, ever published here or elsewhere so far as I have been able to ascertain. As a rule my exposures even then were shorter than one second, but extremely short exposures were difficult to reproduce as halftone reductions. I have noticed, by the way, that for some reason not clearly defined Rieder has gone back to long exposures for pulmonary roentgenography.

You will pardon me for thus lingering fondly over this polliwog period of my roentgenological career. In fact, I may as well confess it, there is still somewhat of the polliwog left in me; and at times I feel that some of our frogs matured perhaps rather prematurely.

As Snook took up a German idea and realized it in the modern interrupterless transformer which has made roentgenography, especially of the lungs, much easier; as Coolidge revolutionized the Crookes tube and gave us the Coolidge tube; so we need some one, some other American if possible, to perfect the Dessauer Blitz-Apparat—a thing I have been urging manufacturers to do for years—and furnish us with the real article, an instrument that will enable us to take a lung, or stomach for that matter, in say one five-hundredth of a second without the aid of intensifying screens and without boring the target. We need it, and therefore we must confidently expect that it will come about.

Now that we are graduating out of the first class of roentgenologists and delegate the picture-making business to assistants (nurses, "sisters," boys, young ladies, medical students, and here and there perhaps a genuine expert technician) and have more leisure for the professional study of plates, it is but reasonable to expect of us better interpretations.

It pleases me to state from personal observation that some have justified this expectation by their superior work. Too many, however, have not yet. Now there is a very good reason for this. We read

marvelous tales of former polyhistorymen who were pre-eminent in botany, zoology, geology, psychology, mathematics, metaphysics and theology, who knew a dozen or more dead and living languages and who were besides accomplished artists—artists in painting, music, sculpture, architecture —and artists of the logos: poetry, oratory, and literature. I have also come across physicians who serve as multi-specialists. The Dutch have a way of dubbing such pan-prodigies as "men of twelve trades and thirteen failures."

Now it seems to me that the latter-day professional roentgenologist is in a predicament somewhat similar to that of the encyclopedic polyhistor, polyglot, polygraphic, polypragmatic polyp of scholastic, prescientific days. He has too many irons in the fire. He has more specialties than he can manage. The real specialist does not and cannot take him quite seriously and is only tolerating him good naturedly until he can permanently dispense with his services by taking upon himself to do the work that naturally and by right and reason belongs to him and to no one else. The roentgenologist as such, according to my opinion and contrary to that of some present, is an artifact, a temporary by-product of medicine who in due time will fall by the wayside or find his way back into the regular ranks. Not until then shall the present roentgenological epicycle be completed and the mission of the roentgenologist fully discharged.

It is as such a by-product myself that I approach the consideration of certain roentgenological topics of pulmonary phthisis, as a roentgenologist, that is to say, who would make use of the roentgen rays as he may of the trocar, which likewise constitutes one means of diagnosis and of treatment but a poor basis upon which to construct a specialty.

At once we meet with serious difficulties. The average roentgenologist, among whom I take my place, is not yet at present chiefly and first of all pathologist, as he should be. His knowledge of the underlying pathological processes is second hand, or largely so. He looks through other observers' eyes. His mind is biased by what he learns directly or indirectly from them. His apperception being determined by the second-hand mental furniture thus casually acquired as much as by the dots, dashes, "splashes," "fans," "tobacco clouds," "interweavings," "mottlings," etc., which constitute his own special contribution to the work in hand—is it to be wondered at that a study of the literature of roentgenology of the lungs, especially of incipient tuberculosis of the lungs, reveals the fact that the progress made is perhaps not quite satisfactory?

Until we can approach our subject from the view points both of macroscopic and microscopic anatomical pathology and of clinical medicine, we roentgenologists, we peculiarly situated middlemen, should be exceedingly cautious in our deliverances.

When a patient has a hemorrhage of the lungs and the plate shows nothing wrong except a dense spot in the hilus, it is not advisable to tell the attending physician that the hemorrhage is due to the spot opening a blood vessel by scratching it by the movements of respiration. Such stunts do not promote usefulness, nor enhance reputation.

Again—whether pulmonary phthisis is to be conceived of as primarily affecting the blood vessels and is therefore hematogenous, as Aufrecht holds, or is of an aërolymphogenous nature, as Tendeloo maintains, or whether the primary process is acinous-bronchial, are pathological questions which we as roentgenologists should not consider incumbent upon us to settle. Of one such attempt at the third Roentgen Congress in Berlin, Holzknecht spoke sarcastically as a "taking by storm not only the diagnosis of tuberculosis of the lungs but of its pathogenesis as well."

It is, however, an altogether different matter when a roentgenologist notes agreement between his own observations and the findings of the pathologist, and under-

takes to point it out. This I had the pleasure of doing at the 1911 Meeting of the American Roentgen Ray Society, quoting Tendeloo as saying: "It has been accepted for a long time that pulmonary tuberculosis begins in the apex of that organ. But this is an error that has caused much confusion. Where do we find the foci? A primary tuberculous pulmonary focus often begins in the apex, but also often in other parts of the lungs. By far the most foci are to be found in the paravertebral cranial part of the lung, that is, in the pulmonary sector close to the vertebral column, cranial from the fifth rib about between the hilus and the apex, including the apex. The physician who examines only the apex and not the paravertebral cranial part of the lung does not fail again and again to overlook beginning tuberculosis."

This corresponds exactly with the region where early roentgenography most frequently detected changes. It is the domain of the vertebral branch of the upper lobe bronchus, the posterior division of which, according to the extensive investigations of Birch-Hirschfeld, is frequently stunted, distorted and kinked. Schmorl recognized a groove caused by pressure of the first rib in adults and sees in this the cause of the stunting, kinking and distortion of this particular division of the bronchus whose linear markings Dunham sees behind the first rib.

Bacmeister was able to produce in young rabbits an isolated apical tuberculosis in the region of Schmorl's furrow by causing a slowly increasing pressure-stenosis and subsequent direct and indirect hematogenous infection.

Tendeloo finds the primary foci in places where the respiratory movements of the lymph are slightest—" in peribronchial perivascular tissue and the under parts of the pleural and subpleural lymphatics, or in lymphadenoid tissue. . . . These movements depend on the respiratory movements of the air vesicles, which are not equal in all parts of the lungs; those of the paravertebral cranial vesicles are the slightest, and from here they increase in all directions."

Nikol accepts Tendeloo's observations on the respiratory movements of the air vesicles and their influence in creating a vulnerable zone which he locates, as does Tendeloo (and upon his authority), in the same region, though not in the same tissues; Tendeloo using his observations on the respiratory movements of the air vesicles to support his theory of the lymphogenous origin of pulmonary tuberculosis, while Nikol adapts the same observations of Tendeloo for further development of his own bronchogenous theory. In inhalation experiments, dust settles in this region first and mostly, and it is the last region to clear up. Here Babcock locates his primary clinical focus, "a point about an inch or an inch and a half below the extreme summit of the lung and somewhat nearer its posterior and outer border." "From this," he continues, "it spreads downward and backward and hence should be sought for in the suprascapular region, since clinical signs of disease may be discovered here before they appear in front. From this primary focus the lesions often spread downward along the anterior aspect of the upper lobe, about three-fourths of an inch within the margin, frequently occurring in scattered nodules, separated perhaps by an inch or more of healthy tissue. It is not unusual to find in these scattered nodules the only evidence of disease of the lungs when posteriorly excavation has advanced to such a degree that but little more than the pleura remains."

Such correlations as these are useful to the roentgenologist in his difficult task of reading plates. But what we really need is a rounded-out conception of the pathogenesis of pulmonary phthisis, a macroscopic, if not a microscopic, consistent pathology as a common basis upon which clinician and roentgenologist can meet, understand each other, and co-operate. The language of the plate is not in terms of râles and resonances, but refers to visible lung changes; it is of sight, not of hearing.

Both constitute systems of symbols and as such both are more or less unreal. Unfortunately we cannot put them on a graphonola or Victor machine and by means of a steel needle interpret it by retrotransformation. Nor can we profitably read one set of symbols in terms of the other. Both râles and resonances on the one hand, and the cabalistic configurations of the roentgen plate on the other, speak for more or less gross lung changes, the exact character of which must be left to the pathologist, not the roentgenologist, to determine. He is the logical umpire.

If men like Aufrecht, Tendeloo, and Nikol would add roentgenology to the other physical methods employed by them, we should soon be in possession of a body of facts useful to both clinician and roentgenologist. And now that the pathologist can hire a technician, there is nothing to hinder him from doing this and we may look to more rapid progress in the near future. Meanwhile we roentgenologists shall have to continue to cross-question the pathologist and try to correlate as best we may our own hieroglyphics with the direct information he may give us.

What, then, are some of these roentgen signs and what do pathologists offer that may help us to recognize them and to name them?

First of all let us listen to Dr. Kennon Dunham: "I am sure that the increase in the hilus shadows, the thickening of the trunks, together with such alterations in the linear markings as increase in density and breadth, studding, interweaving and extension to the periphery, constitute a shadow picture characteristic of early tuberculosis. . . . If the linear markings in the limited area are sharply defined and dense and show clear cut studdings beyond the trunks, a healed lesion is suggested. . . . The moderately advanced and advanced cases of pulmonary tuberculosis are readily recognized. In the less advanced cases careful study will disclose the alterations in the linear markings, heavy trunks, and hilus shadows previously described. If in such cases the fine linear markings of certain trunks are fuzzy or seem to emerge from a cloud effect such as a film of tobacco smoke, active tuberculosis would be suggested." This describes in Dunham's own language a roentgenographic vision which all have seen, no doubt, but which he has singled out as no one else has done and which he uses as a key to decipher the roentgen code of pulmonary phthisis. For this and for his volume of stereoroentgenograms illustrating his theory, he deserves great credit, no matter what the final verdict as to their significance may be.

By way of contrast let us now compare with Dunham's characteristic roentgen signs those of F. S. Bissell and E. T. F. Richards: "The earliest and only characteristic roentgen signs of pulmonary tuberculosis are minute islets of increased density which tend to group themselves in a typical manner in certain elected localities in the lung. . . . These are roentgenological tubercles. . . . Their first points of election appear to be (a) in the first and second interspaces near the median triangle and (b) toward the periphery. . . . As the process goes on to repair, with hyperplasia of fibroblasts and the formation of connective tissue, the field in which the tubercles lie becomes much broken in appearance and marked by interweaving striæ of increased density. This 'network' may remain after the lesion has healed and all evidence of tuberculosis has disappeared, so that we do not consider its presence alone of diagnostic value. We must remember too that fibrosis and thickening of the bronchial arborizations may be the result of other irritants than those due to the bacillus tuberculosis, and as we have encountered this 'network' so frequently in other lung infections we have come to consider it of little value except as a corroborative sign. . . . It is apparent that many men rely entirely upon this broken field for their early diagnosis, and this must inevitably lead to many erorrs." These authors, basing their conclusions on 219 cases, recognize as well as Dunham that "an ac-

tive or recent lesion is much more prone to appear in continuity with a chain leading toward the hilus."

Assmann points out that whereas formerly the examination of the apices was considered of prime importance, the region below the apex between hilus and clavicle at present receives more attention. But since he too considers mottling the most important early roentgen sign, as Grau has shown, and since these mottlings are often obscured in this region by dense hilus ramifications, he prefers the apex plate to bring them out more clearly than is possible elsewhere.

According to Rieder: "The extension of the tubercular disease or the flaring up of a latent tuberculosis acquired in infancy, takes place, as roentgenological investigations prove, not only in children but also in adults, from the hilus outward and not from the apex. Its farther extension, often on both sides, follows the three larger hilus ramifications, most frequently the upper, less often the middle, seldom the lower branches."

Byshell regards "definite mottlings and nodules at the roots of the lungs as the only reliable evidence of tuberculosis." Melville expresses himself thus: "The one and absolute evidence is the presence in part or parts of the lungs of the characteristic fine mottling."

Jordan thinks that the linear shadows may be traced even to the periphery of the chest in healthy persons but that mottling is the evidence of active disease. Hence he cautions us not to diagnose phthisis "unless you can show mottling through a small aperture and show it on a photographic plate."

It would be instructive in more ways than one, and besides highly interesting, to submit to all of the authors quoted a series of plates of early tuberculosis for description and interpretation. Each would go at it according to what psychologists call, I believe, his *apperceptive mass*. That, of course, is inevitable. I imagine Dunham gazing into the mirror of the stereoscope and saying: "I see characteristic fan-shaped densities which extend from the pleura to the hilus with the apex of the triangle toward the hilus; the base of the fan is outward and backward behind the first interspace, the linear markings are replaced by an intricate fine network which is veiled somewhat as if by a cloud of tobacco smoke. What I see is characteristic, that is, pathognomonic of early tuberculosis."

If his friend Dr. Wolman were present he would undoubtedly remark (and this is his actual language): "I conceived at first a profound distrust of diagnoses that had to be based on Dr. Dunham's peculiar stereoscope markings. But now I can testify to my conversion to a belief in these same scorned markings, these mysterious markings for which we know no acceptable explanation. However, after subjecting them to a severe *clinical* test, I can state that undeniably they possess empirical truth."

Baetjer, no doubt, on hearing this would repeat what he had said before: "This method of diagnosis is empirical, as Dr. Wolman may well say, and has no known pathological basis, and has been substantiated by clinical findings only. Now it seems to me that this is the point where error could so easily creep in. Clinical findings do not constitute absolute proof. Besides, it seems to me that any chronic infection of the lungs could just as easily produce changes in the bands which carry the artery, vein and bronchus. In emphysema and chronic bronchitis we see a marked thickening of these bands extending throughout the lungs. I agree with Dr. Dunham that the irregularities along these linear markings which he has termed 'fuzzy' are collections of small tubercles but they are seen in a later stage of the disease."

Assmann looking over the same plates would agree as to the final diagnosis, but not until he had supplemented the examination of the stereogram with a minute scrutiny of apex views of the same case, because the

hilus strands are dense and obscure the mottling, which he also insists upon as the characteristic and only characteristic roentgen sign, if there be such, of early tuberculosis of the lungs.

All others present would concur in the final diagnosis; but they would reach it by different approaches. Even Rieder, while on the lookout for his particular own roentgen signs of cavitation in early tuberculosis—and probably finding them, too, while others overlooked them through lack of equal preparedness of their apperceptive masses—even Rieder would not be likely to overlook Dunham's "fan," for he seems to be quite familiar with it in all its details. In his book (Rieder and Rosenthal, Fig. 31, p. 278) he gives one of his characteristic schematic representations of it. His own pathological bias, however, must be held responsible for his description of the interweaving part of the fan as "net-like branchings of swollen lymph vessels."

The other day, talking with a friend about characteristic roentgen signs of early phthisis I noticed he used the word "characteristic" in a sense peculiar to himself. He contended that the words "characteristic" and "pathognomonic" meant different things. Nor would he yield the point until he was shown in Webster: "Pathognomonic, Med., characteristic of a disease."

Now it occurs to me that after listening to all of our roentgenological authors with keen interest and thorough appreciation of the excellence of their work, many of us present might feel that their differences, after all, were less vital than their agreements and that the difficulties may perhaps be partly due to misunderstanding—a matter of language, of English. Differences that cannot be accounted for on this score may, for aught I know, be charged to diversity of apperceptive masses.

The question is still an open one, therefore, whether there are such things as pathognomonic roentgen signs of pulmonary tuberculosis. Bandelier-Roepke, for instance, maintains that there is nothing in an *x*-ray plate of a tuberculous lung that is characteristic or pathognomonic of the disease. Strictly speaking, this may, no doubt, be true. The direct diagnosis of tuberculosis of the lungs by means of roentgenography, like the direct positive diagnosis of ulcer of the bulbus duodeni, may be, "strictly speaking," unwarranted. For the sake of argument we may admit that just as other lesions besides an ulcer can produce "characteristic" bulb deformity, so also the "characteristic" signs of pulmonary phthisis may be produced by other pathological processes. Well, neither are there, as Babcock points out, auscultatory phenomena which are pathognomonic of early tuberculosis. Practically, however, we shall seldom go wrong in the case of pulmonary tuberculosis, especially if, instead of relying exclusively on one so-called characteristic sign, we look with a thus enlarged apperceptive mass for all of the characteristic signs known or possible. For it is a fact of which we as roentgenologists may well be proud that, in spite of all difficulties inherent in the problem itself and of those growing out of the subjectivity of the examiner, a striking unanimity of final diagnosis is reached when variously disposed and predisposed experts examine the same plates. This is in happy contrast with what Babcock, himself a well-nigh preternaturally expert percussor, says of percussion, which by some is considered equal or superior to roentgenography: "So much depends upon the skill of the examiner in practicing this mode of chest examination that two or more men may draw different conclusions from percussion of a case at the same sitting."

We are approaching, though we have not yet reached, direct diagnosis. Careful roentgenologists will render such tentatively only. But, of course, we cannot rest satisfied until this too can be done, giving a positive or negative result, and that unhesitatingly. Some characteristic roentgen signs which are always present, always recognizable, never due to anything else, even though empirical, would do. But while waiting for pathology to determine the

archtypal basis needed for interpreting the ectypal roentgenogram, which must take some time, may it not be possible to discover a heuristic principle, some temporary working hypothesis to help us out? Anything relatively fixed is better than wind and waves.

Classification such as that of Cornet, which reduces the polymorphous lung changes of pulmonary phthisis to two main processes—tuberculous peribronchitis and caseous pneumonia—and which also does justice to Orth's conception of the dualistic nature of the histological changes involved as proliferating and exudative, has in its favor that it is at least simple.

The main objection to this division lies in the vagueness of the conception "peribronchitis." This also applies to Assmann's assumption that the peribronchial tubercle constitutes the prototype of all tuberculous lung changes. For the same reason Nikol takes pains to show that Ziegler describes as broncho-pneumonic nodules lesions which Orth designates as tuberculous bronchitis and peribronchitis, while Abrikosof, who constantly speaks of bronchitis and peribronchitis, seems to identify peribronchitis with lymphangitis tubercolosa peribronchialis.

Assmann adds to the confusion when he classifies his peribronchial tubercles as miliary tubercles, a term which is reserved by common practice to the hematogenous variety, though it is true that it may be difficult at times to distinguish between the two in the roentgenogram.

Assmann cautions us not to regard the roentgen appearance of miliary tuberculosis as pathognomonic and reports a case of bronchiolitis obliterans, diagnosed clinically and roentgenographically as miliary tuberculosis, the real nature of the lesions being revealed at autopsy. He also tells of a post-mortem on a patient who had died of puerperal septicemia whose lungs were studded with minute abscesses of the size of the head of a pin, which probably would have appeared on the plate like miliary tubercles. Unfortunately a roentgenogram was not made. But aside from rare instances such as these, and possibly of miliary carcinosis, the more or less distinct general mottling of disseminate miliary tuberculosis constitutes a roentgen sign of tuberculosis that is well nigh pathognomonic.

A roentgenogram of the lungs shows hilus, hilus ramifications and parenchyma. No matter how biased, whether we believe the bronchi, the lymphatics, or bloodvessels to be chiefly or primarily involved, we satisfy the demands of bronchogenists, lymphatogenists and hematogenists alike if we approach the study of the roentgenogram by way of the hilus ramifications in all cases not clearly miliary. These ramifications represent the triple track military highways which the invading enemy must take. In these or in their vicinity we must expect to find the early signs of his trenches.

We may specify farther:—Since Tendeloo, Birch-Hirschfeld and Nikol, though they disagree absolutely on the pathogenesis of pulmonary phthisis, are agreed that what Tendeloo has determined to be the area of the greatest biochemical susceptibility, is also first involved—we have good reason for concentrating our attention upon this area.

Tendeloo's region corresponds to the hilus and hilus ramifications which follow the course of the upper vertebral branch of the upper lobe bronchus, and it is interesting to note that roentgenologists have long ago learned to look upon this identical region as the one to be suspected before all others, not from any pathological or clinical bias, in fact in spite of clinical teaching, but because their experience very soon taught them to look for changes where they were found most constantly and most abundantly in early cases.

Necessarily, the first changes to attract attention were those of the regional glands, of the "dustbins and lethal chambers" as someone has aptly called them, that drain the area of greatest biochemical susceptibility.

With the advent of short exposure tech-

nic, changes were detected along this ramification higher up as well, often of a more delicate nature, until now the distal endings reveal even more characteristic changes than does the hilus. At the periphery, the bacilli are first halted and the earliest signs in adults are to be expected there.

According to Gohn, and as is now well recognized, the location of the primary focus in children is much more inconstant. Gohn's tubercle may be found almost anywhere. According to Gohn himself it is located more frequently in the anterior portion of the upper lobes—just the opposite from adults—and in the posterior portion of the lower. It may be actively progressing or more commonly obsolete, frequently very small, a mere little scar, though the tracheal and hilus glands show extensive and rapidly progressing involvement, as if on account of the greater permeability of the mucous membranes and better functioning lymphatics of children, the bacilli are swept almost immediately into the dustbins at the roots of the lungs.

Not only as depending upon the age of the patient but also as directly and inversely proportional to the virulence of the infection, and the inherited and acquired resistance of the host, the type of the disease must differ from the very start. We should expect to find, therefore, early signs of acute and of more chronic forms, and look for them not merely in one location but everywhere according to age of the patient and circumstances.

Combinations of various pathological conditions occur in one and the same case. One form of the disease may change into another. Chronic types become acute, and vice versa. To note differences of density, hence, to distinguish, constitutes the very life and soul of roentgenology; a reason the more why we should purposely guard against making too sharp distinctions, as against a tendency growing out of the very nature of our work—lest it become a bad habit.

With this caution and with the exception of miliary tuberculosis and the special type of the disease common to children, we are justified in assuming therefore that the early lesions will be found as described.

Of the several types of early lesions as well as of more advanced forms of the disease, Assmann has published good illustrations. Dunham has not found it possible to reproduce the earliest lesions as stereographic reductions on account of the difficulty and expense, and gives only two illustrations of "early" tuberculosis.

Since, as we have seen, the location of the early lesion is determined by the hilus ramifications, that is to say, by the anatomical structure of the lung itself, the suggestion arises that its histology also may depend upon the same general factor. The results of Nikol's investigations make it highly probable that this indeed is the case. He finds that the most typical of all lung lesions, the acinous nodular focus, depends for its location and macroscopic and microscopic appearances upon the anatomy of the structural unit of all lung tissues, the lobulus.

This lobule is made up of an intralobular bronchus giving off two or three collaterals and two terminal bronchi with their dichotomous bronchioli, each again giving off smaller branches. The terminal structure is the acinus bronchiolus. This corresponds to the bronchiolus respiratorius, as given in Quain's Anatomy. Here the alveoli begin and ciliated epithelium leaves off. Each bronchiolus gives off three or four alveolar passages. An acinus, therefore, is the domain of a bronchiolus respiratorius with the alveolar passages appertaining to it. Acini are more uniform in size than lobuli. A lobule contains from fifty to one hundred acini. Lobules do not anastomose but interdigitate with each other, as do also their accompanying lymphatics and bloodvessels.

The bronchiolus respiratorius is first involved in acinous tuberculosis as well as in non-tuberculous bronchopneumonia. The acinous foci conglomerate into small and larger sized nodules. From the start there

is apparent a tendency toward induration and hence this form belongs to the chronic and subacute variety.

Macroscopically the acinous nodular focus appears as a conglomerate of small greyish blue bodies which look like miliary tubercles. They differ in that miliary tubercles are more evenly distributed over the entire lung, diminishing in size from apex to base, while acinous foci occur in groups at the end of the bronchi and form clover leaf and rosette-like bodies.

These foci have hitherto been variously described as peribronchial tubercles (Assmann); or as walnut-sized and larger foci of fibrous groundwork in which grey or yellow nodules of the size of a millet seed are imbedded (Orth).

The distal portion of Dunham's "fan" is probably made up of acinous nodular foci of Nikol, the central induration obscuring the nodules and accounting for the clouding.

The rosettes of millet-seed-sized nodules, softer and earlier, may stand for the islets of mottling so strenuously insisted upon by most others as an earlier and even more characteristic sign.

The leaves (mottling) which hide the branches in spring and summer, after falling leave the bare branches standing out boldly as against a clear sky, when healing has taken place. Viewed after this manner, the acinous nodular focus assumes preeminence as the prototype not only of one form of chronic and subacute phthisis, but of caseous bronchopneumonia and tuberculous bronchitis as well.

The acinous nodular focus thus becomes the keystone which finishes and supports the entire pathological arch and the key to the crypto-roentgenogram.

How this is accomplished by Nikol for pathology and how to correlate the data thus obtained with those of the plates, we have no time now to pursue any farther.

If, by condensing the fog, I have succeeded in a measure in clearing the atmosphere, and in pointing out a way toward a more consistent and comprehensive view, I trust I have contributed to a better understanding of the subject among ourselves.

AN APPRECIATION OF THE ROENTGEN RAY AND A WARNING AS TO ITS USE IN SURGICAL DIAGNOSIS*

BY CHARLES H. MAYO, M.D.

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IN this age of science medical progress has fully kept pace with other sciences. The most important discovery was the function of the single cell, and to-day the smallest element has become the subject of the greatest study. With the knowledge that microorganisms are the specific cause of disease, progress became rapid; in fact almost a new medicine has been written along broader lines.

Within the activities of many of us marvelous discoveries have been made. In mechanics, the submarine, wireless telegraphy and aviation; in medicine, among others, the roentgen ray and radium. The latter have been found to be of such aid in the treatment of disease that they constitute specialties in which many hundreds of physicians are now engaged.

When the main principles of a science are discovered its progress is unceasing as our knowledge increases. From the old glass and mica-plate static battery we passed through the use of several forms of coils, until now machines and tubes, as well as methods, have become standardized. The

* Presented before the American Roentgen Ray Society, Chicago, Sept. 28, 1916.

roentgenologist knows almost exactly what to expect, the roentgen ray having opened the windows for the observation of new truths to prove or disprove the correctness of old theories.

Naturally, from the penetrating character of the ray, its first aid to medicine and surgery was in outlining the bony skeleton. It showed deformities and anomalies, and above all afforded perfect observation of fractures. The treatment of certain fractures has been almost revolutionized by early diagnosis and aid in adjustment, and surgeons have become convinced of the necessity of the open method of treatment in cases of failure of adjustment. At various ages the bones of the body have a characteristic roentgen appearance. Because of this, diseases of the bones and joints, which cause deviations from the normal appearance, have become, as it were, an open book. However, with the roentgen picture came the danger of failure to properly interpret it. Many operations far too radical, such as amputation of limbs, have been advised in the belief that death from sarcoma would otherwise result, when as a matter of fact the disease was but bone cyst or cartilaginous tumor. The great value of the ray has been demonstrated to the surgeon also as a means of locating foreign bodies, such as needles, bullets and glass in the tissues of the body or in the alimentary tract, indicating whether in such cases surgery is necessary, and when necessary, preventing over-extensive dissection.

Further advance in the use of roentgen ray as a diagnostic measure came in the roentgenoscopic and roentgenographic examination of the chest. The size of the heart and aorta is easily determined, and in diseases of the lungs, especially the early stages of tuberculosis, fibrosis, local bronchiectasis, and cavitations, the diagnosis is more sure and definite than by previous clinical methods. In diseases of the pleura with exudate, fistulas in general and cases of empyema, especially, opaque solutions are injected to outline the size and shape of cavities. In this manner the value of Beck's paste in diagnosis and treatment was discovered. Especially important is the aid of the roentgen ray in the diagnosis of early metastatic carcinoma of the lung and bones. In these cases the roentgen findings prevent serious primary or secondary operations when the original lesion is in the mammary gland or thyroid. When such malignancy has existed for more than a year there may be 14 per cent of metastases to lung and bone. I believe that these structures should not be treated surgically when such metastatic growths are found and that other forms of treatment have greater influence in prolonging the life and comfort of the sufferers.

It is now possible to outline the whole alimentary tract from the esophagus to the anus by roentgenoscopy or the roentgenogram. Diverticula in the esophagus may have been previously diagnosed, but the ray shows when there are large sacs extending into the chest and indicates to the surgeon when a two-stage operation should be done to prevent danger of infecting the mediastinal space, a complication that is usually fatal. Also by means of the ray foreign bodies, strictures, and the dilatation accompanying cardiospasm are shown, all of which findings aid wonderfully in the diagnosis.

In diseases of the stomach the surgeon depends largely on the roentgen ray to identify and locate the niche of ulcer, hourglass stomach, the location and operability of cancer of the stomach, contractions at the pylorus and foreign bodies; also to ascertain whether a palpable epigastric mass is intrinsic or extrinsic. Formerly such conditions were often diagnosed as surgical lesions and a complete diagnosis was revealed only by exploration. Thus many persons suffering from inoperable carcinoma have been subjected to unnecessary operation, their vitality being thereby impaired without adequate benefit.

Probably no organ in the body is more often the seat of common complaint than the stomach but, as W. J. Mayo says, "so

frequently are those symptoms reflex that only one person in ten who complain of gastric trouble as the major symptom actually has disease of the stomach." In an extremely high percentage of cases duodenal ulcer is diagnosed by bulbar deformity, obstruction and hyperperistalsis. Secondary manifestations in the stomach such as spasm of the pylorus, hyperperistalsis, etc., often indicate infection of the gallbladder with or without adhesions. The complaint referred to this region is probably more exaggerated than that referred to any other region in the body, unless it is the female pelvis, and it has often a hypnotic influence. However, it is the examiner who receives the suggestion and is led to exaggerate the findings. The unfortunate surgeon failing to find the supposed lesion pleases neither the patient nor the diagnostician. It is to be deplored that so many suggestions coming from the profession are of disease rather than health.

The ray is useful more often in diseases of the colon than in those of the small intestine. In both intestines, however, tumors, chronic obstruction, dilatation and stasis show remarkably well and in a large majority of cases the roentgenologic findings can be depended on as a means of diagnosis.

The medical literature of the past few years has been filled with descriptions of colonic stasis, ptosis of the abdominal organs and methods of operative relief. The stomach and colon being easily located in the roentgenogram readily show changes of position which are often supposed to be abnormal and have led to much inadvisable surgery. Those engaged in specialties occasionally fail to comprehend the association of general diseases, the habitus, the muscle tonus, the height, breadth, weight and the influence of environment, and the narrowness of the viewpoint of the specialist often accounts for the unwarranted operation recommended.

The surgeon is frequently confronted by patients who have been hypnotized by the suggestion of physicians into believing they have disease. These patients appear with a box of roentgenograms showing that their stomachs are low. Their physicians have recommended gastroenterostomies or colectomies, although there is but slight, if any, delay in the emptying time. Such persons are usually women, though sometimes they are men, still worse subjects. They have weak muscles, are usually tall, narrow of girth and long of loin, and therefore it would be surprising to find that the longitudinal muscles of their colon were in proper tone. With but a few inches of lateral width in which to attach 24 inches of transverse colon, the latter naturally hangs lower. If stasis is present these patients have been told that all their ills, mental and physical, will be relieved by elevating or shortening the colon, and the surgeon who refuses to operate is looked upon as an obstructionist.

In genito-urinary work the surgeon is appreciative of the great aid afforded by the *x*-ray in diseases of the ureter and kidney. The shape and capacity of the pelvis of the kidney, the location of stones in the kidney or ureter, as well as their number, are often shown. A knowledge of the presence of multiple stones is of the greatest importance as it is generally believed that recurrence of stone in the kidney occurs in 50 per cent of the cases. In a series in our clinic of 450 cases of stone in the kidney operated on more than a year ago the actual percentage of recurrence was 9.9, but the number of multiple stones diagnosed and removed was high. Deformities of the pelvis of the kidney are outlined by the pyelogram, thus making possible early diagnosis and operation on hypernephroma.

Diseases of the gallbladder are the result of infections, specific types of streptococci having been brought to the base of the mucosa by the vascular stream. Gallstones do not develop without previous inflammation of the gallbladder. Undoubtedly a great deal of effort has been wasted by the roentgenologist in endeavoring to diagnose gallstones. To be sure, it can be done in a

certain percentage of cases, but if even done correctly in 100 per cent—and it is correct in scarcely half that number—the method avails nothing in the group of patients suffering from cholecystitis without stones, strawberry gallbladder, papillary gallbladder, and even early carcinoma patients, who make up more than one-third of the total number of those with disease of the gallbladder. To depend on the roentgen ray in these cases, except as a corroboration of the clinical diagnosis by indicating the probable presence of stones, would be to step back in the clinical progress of medicine at least twelve years.

In the present period of medical advance the chief subject under discussion is the focal origin of disease, both general and local. Very frequently foci of disease are carried by those suffering from chronic relapsing rheumatism, neuritis, myositis, etc. One of the most common sources of such infection are painless apical abscesses in the jaw which empty into the circulation from time to time through the venous channels in the bone, each delivery constituting a new attack, a so-called relapse. In the search for such foci of infection the roentgen ray quite naturally supersedes all other means of examination.

What the surgeon most desires in his report from the roentgenologist is brevity like that of pathologists' reports regarding diseased tissues. A detailed statement of the various types of cells and tissue-structures sent to a man who is not an expert fogs his mind and clouds the clinical evidence previously obtained. To stand well with the surgeon, the roentgenologist should be specific in his conclusions, avoid verbose descriptions of his findings, and when unable to make a diagnosis, frankly report the case as "indeterminate."

The modern roentgenogram may be accurate, but man is not infallible. The specialists making roentgen-ray examinations seldom have the opportunity to follow their patients to the operating table and visualize the abdominal contents directly. Moreover, they do not have the opportunity to correlate their findings with those of equally good men who are quite as anxious to show the importance of laboratory and clinical tests and well-taken histories. Only by such correlation can a normal, wholesome restraint be established and the greatest proficiency in clinical diagnosis be attained.

ROUTINE TECHNIC OF BARIUM DIAGNOSIS*

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ONE of the most important, necessary and fruitful fields of roentgenology is the diagnostic examination of the gastrointestinal tract. This, like all other roentgenological examinations, consists in the study of shadows, special attention being paid to size, shape and position of the organs, as viewed at various angles and distances, in order to establish the presence or absence of normal or pathological conditions.

The normal intestine of the adult does not cast a shadow, being permeable to the roentgen ray, and in order to obtain a shadow of the intestine itself, of its contents and the movements thereof, an opaque substance is introduced by mouth, rectum, or both, according to the parts to be examined and the conditions to be elucidated.

There are a number of different methods in use in regard to composition and consis-

* Read at a Meeting of Roentgenologists in Detroit, Mich., February 5, 1916.

tency of the meal as well as to the method of its administration. Some prefer as a suspension medium a mixture of bread and milk, others of cornflour, arrowroot, porridge, blanc mange, jelly, lactose emulsions, gum solutions, thick butter milk, oriental clotted milk, hot malted milk, hot malted nuts, etc. The contrasting mediums are principally confined to a choice between the bismuth and barium salts, aside from water, air and gas insufflation. This would lead one to suppose that no one method is suitable to be adopted as a standard, but this is only true to a limited extent. No doubt conditions may arise in individual cases which have to be met in different ways, but the principal reasons for the prevailing divergencies of opinion are (1) that the profession is not yet sufficiently acquainted with the merits and demerits of the various substances and methods and (2) that the individual physician lacks the opportunity and material for making extensive studies and observations in this direction. For this reason, he is prone to recommend one particular method which happened to give satisfactory results in a particular case and which, in the absence of comparable knowledge, he considers equally satisfactory in all.

The Battle Creek Sanitarium has an unusually large material at its disposal, a considerable percentage of its patients being subjected to roentgenological examinations not only for gastrointestinal complaints, but also for the demonstration of numerous other conditions and disorders in which the application of the roentgen method has proved serviceable. Thus, before performing a laparotomy, as hysterectomy or, in fact, any abdominal operation, the Sanitarium surgeons refer their patients to the Roentgen Department for examination. This method, which was encouraged by Dr. Kellogg and carried into practice by Dr. Case and his colleagues, has not only been the means of largely increasing the roentgenological material, but also of disclosing before operation numerous unsuspected conditions which demand or contraindicate a certain line of treatment.

I have therefore thought it a timely and acceptable topic to discuss before you the routine technic of barium examinations, to the elaboration of which Dr. Case has devoted eight years of close study, observation and experimentation.

As far back as January, 1912, Case explained this routine technic which represents the Battle Creek method, before the Royal Society of Medicine in London, Section of Electrotherapeutics, and yet when in November, 1913, the same Section met to discuss the technic and standardization of the gastrointestinal tract, the diversity of opinions was so great as to make it doubtful whether they could ever be brought to agree. The question even arose whether it was worth while troubling about a standardization at all, as long as the results obtained with different methods were equally good. Aside from the fact that that is only apparently so on superficial observation and only in a limited number of cases, the fact we have to deal with is that roentgenology is still a young science which has to be further evolved and developed on the ground of practical daily experience of that part of the profession that has made its application and study a specialty. It is not the individual case we are satisfied in treating; it is the diseased condition in a large number of individuals for which we have to establish the best method of examination, diagnosis and treatment.

With this object in our minds, it is not sufficient merely to obtain good results, but we must have results which, in the language of Reginald Morton, the president of the convention referred to, are comparable. This desideratum, however, can only be achieved by resorting to standardization, and Dr. Morton was right in stating that the limitations of standardization limit the progress of medical science.

As to the salts employed, A. F. Hertz states that bismuth carbonate neutralized every trace of free and organically com-

bined hydrochloric acid in the stomach. This, in view of Cannon's theory of acid control of the pylorus, would account for the long delay of this meal in the stomach.

Bismuth oxychloride is inert in the stomach and small intestine, except when sulphuretted hydrogen has developed as a result of abnormal putrefaction. This gas is a powerful stimulant to intestinal movements, but is inert when entering into composition with bismuth oxychloride.

Bismuth subnitrate is objectionable for examinations of the gastrointestinal canal, because in the presence of putrefaction it undergoes changes resulting in the formation of nitrites which, of course, are poisonous.

Barium sulphate is as efficacious as bismuth salts in rendering the stomach and intestine visible in *x*-ray examinations. It is completely insoluble in water and acids, and no organic solution acts upon it. It has all the advantages of bismuth salts with none of their disadvantages, and has the additional charm of being much cheaper.

In the Battle Creek Sanitarium, barium sulphate is the contrasting medium used, but we have found that it is not the mere swallowing of a satisfactory opaque substance which makes for complete satisfaction in regard to all the results to be considered, but also the adaptation of the process to the natural conditions of taking food. This includes the administration of part of the food in a hot condition and in different palatable preparations, taken at the regular mealtime.

The barium meal, as elaborated by Dr. Case and administered to over eight thousand patients, consists of two and a quarter ounces of barium sulphate, one-quarter ounce of which is given in a third of a glass of water. This mixture is given the patient first, because it passes into the duodenum without exciting any pyloric sphincter action, and we are often able by this means to outline at once the entire duodenum. The remainder of the barium—two ounces—is divided equally into a glass of hot malted nuts and a glass of oriental clotted milk. The malted nut preparation is a proprietary food and constitutes one of the best mediums of suspension. This meal averages about fifteen or sixteen ounces. Repeated experiments have demonstrated the fact that the liquid meal gives immediately a better and more satisfactory outline of the gastric shadow than the semi-solid meal, while the emptying time of the stomach is about the same.

The condition of the bowels before the administration of the roentgen meal is also a matter of consideration, and the advisability of giving laxatives preceding the opaque meal is a much-debated point. Gompertz and Richard have found no appreciable change in either case, but inasmuch as their test was confined to a paltry four cases and directed to motility only, which is but a fractional part of the roentgen findings, their investigations are devoid of practical significance. No doubt more extensive research would have revealed very decided changes resulting from the use of laxatives.

As an argument in favor of laxatives, A. F. Hertz states that we wish to see the patient under natural conditions, but that is precisely a reason why laxatives should not be used. Hertz correctly points out that most cases of obstipation are more or less cumulative, that the bowels are never completely evacuated, that more and more feces are retained; increasing from below upward. He correctly concludes that partial obstruction may occur in the higher parts of the colon as a result of such accumulation, although the motor functions of the intestines as far as the pelvirectal flexure may be normal and that, consequently, the activity of all parts of the intestine can only be properly investigated after the colon has been emptied. But all these pathological conditions are the very ones we want to study, while the condition of the empty colon, after the pathological obstruction has been removed, is a matter of secondary interest. The pathological fecal accumulation represents the natural

conditions which may demonstrate exaggerated antiperistalsis, a dilated elongated cecum, an incompetent ileocecal valve, ileac stasis, etc., while removal of the accumulated feces would only demonstrate rectal constipation owing to the barium readily passing into the distal half of the colon, with the result that a very important factor in the diagnosis of the case is lost sight of.

Dr. Case has made numerous experimental investigations, showing spasticity in the distal half of the colon after the administration of laxatives, and absence of spasticity in the identical bowel when no laxative had preceded the test. Russian oil, given before a barium meal, delayed the stomach contents very materially, amounting in one case to more than eight hours. To study the natural conditions, therefore, we deem it very essential that laxatives or enemas should not be given.

The barium meal which was introduced into this country by Dr. Case is given at the Battle Creek Sanitarium at the time and in the place of the usual breakfast, which is 8 o'clock in the morning. This avoids interfering with the regular habits of the patient as far as possible, which is a point of importance. The meal is taken in the upright fluoroscopic cabinet, which enables the immediate recognition of the manner of deglutition, behavior of the esophagus, depth and direction of peristaltic waves, spastic indrawings, etc. The patient is next placed on his right side on the horizontal table, which permits the food to gravitate to the pyloric end of the stomach. The examiner makes pressure on the greater curvature of the stomach toward the pylorus, the patient quickly turning on his back. This pressure serves to hold the barium in the pyloric end of the stomach, causing the duodenal bulb to fill out for purposes of study. Should the latter be unsatisfactory, another examination is made two and a half hours later.

Four and a half hours after the test breakfast, the motility of the stomach is determined. If a residue remains, the amount is estimated and a time set for the patient to partake of lunch so as to ensure complete emptying of the barium meal before the lunch is ingested. Except in cases where there is clinical reason to expect obstruction or unusual delay, a six-hour limit of normal emptying is allowed.

Another observation is made nine and a half hours after the first meal. Any residue in the stomach at that time will show the amount of barium that was in the stomach at the time the patient partook of lunch. Any barium residue in the ileum will allow a fair estimate of the amount of ileac stasis present, the terminal ileum being normally empty at that time.

Normally, all of the barium should be in the colon at the end of nine and a half hours, reaching beyond the middle of the transverse colon and as far as the splenic flexure.

Another observation is made twenty-six hours p.c., at which time the colon is partially emptied under normal conditions, a trace of barium is found in the cecum and ascending colon, while the remainder of the colon is densely filled to the ampulla.

Fifty hours p.c. the patient is again observed, at which time any barium residue in the colon will furnish an estimate of the amount of colonic stasis present. At this hour, the colon is normally cleared of barium, and the examination is terminated unless considerable residues remain, in which event further observations are made at the seventy-fourth or even the ninety-eighth hour.

The next step is to order cleansing enemas in preparation for the injection of the opaque enema. The preparation consists of three small warm enemas given at fifteen-minute intervals in the morning before breakfast. According to our observations, small enemas, repeated at short intervals, accomplish more in cleansing the colon than a single large one. In a number of our patients who had been in the habit of using large enemas for colonic flushing, the colon was enormously and permanently distended.

These cleansing enemas are given at least two hours previous to the barium injection, so that the colon will be thoroughly emptied, and any small remnant of water be absorbed. On the other hand, the time limit should be kept within three hours, as by that time the cecum and terminal ileum are normally beginning to fill with the morning meal.

In this connection it may be stated that the use of the colon tube has proved a failure, aside from the fact of its being totally unnecessary. Any attempt at introducing a tube into the colon is bound to be disappointing on account of the tube doubling up in the rectal ampulla. At the same time, the use of an ordinary rectal tube, introduced just past the sphincter, has been found quite satisfactory, as the liquid promptly fills the entire colon under the pressure of the injection.

The opaque enema, as practiced by Dr. Case, consists of a warm mixture of barium and gum tragacanth. Before the enema is injected, a brief roentgenoscopic glance at the abdomen will determine whether or not there is any barium residue. For instance, a patent, poorly drained, appendix may be discovered, retaining a small residue. We have often discovered multiple diverticula of the colon in this manner. Frequent screen observations are made during the injection of the barium. Obstructions, if any, are noted; likewise the degree of spasticity, the mobility and position of the cecum and the competency or incompetency of the ileocecal valve. Special attention is paid to the movability of the pelvic loop.

In order to obtain the intelligent cooperation of the patients or at least to prevent their ignorantly frustrating the object of the examination, printed directions are handed to them for their guidance to the following effect:

(1) Take no laxatives or enemas (except by special instructions) for at least twenty-four hours before the barium meal, not at any time while the observations are in progress.

(2) Do not take any food, drink or medicine on the morning of the examination before the barium meal has been given in the *x*-ray examining room.

(3) Avoid eating or drinking (except perhaps a small amount of water as may be necessary to allay thirst) after the barium meal, until the stomach has expelled the same. This is usually the case at noon, but you will receive exact information regarding your own case.

(4) Do not take any laxatives, enemas or bowel treatment (except by special arrangement) during the first two days of the barium test.

(5) Women patients will save inconvenience by wearing kimonos.

This completes our ordinary routine method which, as stated before, has been applied to over eight thousand patients with highly satisfactory results. We therefore feel we can recommend this method to all roentgenologists as a standard routine technic which will serve as a reliable basis of comparison and be the means of raising the diagnostic value of the roentgen method for both scientific and practical purposes.

THE USE OF THORIUM IN UROLOGY AND ROENTGENOLOGY*

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A TRUE solution would certainly be preferable for use as a pyelographic medium to the colloidal solutions and suspensions of the salts of the metals that have been used up to the present time. These colloidal solutions and suspensions have been for the most part of the salts of silver, but those of other metals have also been tried. All of these solutions sediment on standing, and while being for the most part quite opaque to the roentgen ray, are viscous, and some of them are quite toxic and irritating.

As the opacity of a substance to the roentgen ray is directly proportional to its atomic weight, thorium, being next to the heaviest known element, is quite ideal theoretically. Many experimental investigations[1] as to its pharmacologic action, and much clinical evidence after a year's experience in its use, have led to the conclusion that it possesses all the qualifications necessary for use as a pyelographic agent. These qualifications are that the solution should be non-toxic (within the ordinary limits of usage), non-irritating, quite opaque to the roentgen ray, and give not only a good shadow but one of clear delineation; it should possess a marked degree of fluidity, permitting its ready escape from the urinary tract; it should be clean so as not to stain everything with which it comes in contact, and be inexpensive so as to be generally used.

It was found that the nitrate and chlorid of thorium were unsuitable for clinical use because of their acid and astringent properties, and also the fact that they precipitate insoluble salts when brought into contact with the urine. They may, however, be used to very great advantage in tracing out the finest hair-line vessels and ducts in pathological specimens. These specimens, after being injected with a solution of these salts, are fixed in Kaiserling's solution, which causes a precipitation of thorium salts in the walls of the vessels and ducts, markedly accentuating their outline in a roentgenogram made of a specimen so prepared.

After a careful study of the various combinations into which the salts of thorium may enter, it was found that a solution containing the double citrate of sodium and thorium together with an excess of sodium citrate and some sodium nitrate, possessed all the requisites necessary for use in pyelography. This solution is prepared in the manner suggested in a previous publication.[2] For pyelograms a solution containing fifteen per cent. of thorium in the form above noted should be used, and for cystograms a ten per cent. solution has been found to be perfectly satisfactory.

The outline of the renal pelvis and ureter, as given by the shadow cast by this solution, is not only quite definite, but the shadow itself is of remarkably clear delineation.

In addition to its great opacity to the roentgen ray, the solution, either by its adhesive properties, by its capability of being absorbed by calculi, or by means of its comparative density, accentuates the shadows of calculi in the urinary tract when they are not ordinarily seen in plain roentgen ray plates.

The solution is clear and watery, therefore perfectly clean, and in this particular possesses another marked advantage over the solutions of the silver salts now in use.

[1] Burns, J. E., "Thorium—A New Agent for Pyelography." Bulletin of the Johns Hopkins Hospital, Vol. XXVII, June, 1916 pp. 156–164.

[2] Burns, J. E. "Thorium—A New Agent for Pyelography." Preliminary Report, *J. A. M. A.*, June 26, 1915, Vol. LXIV, pp. 2126 and 2127.

* From the James Buchanan Brady Urological Institute.

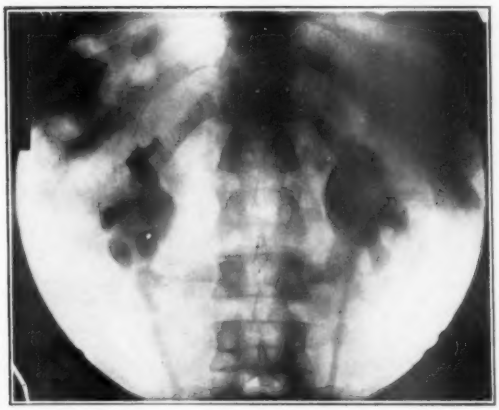

FIG. 1. DOUBLE PYELOGRAM SHOWING THE SAME TYPE OF RENAL PELVIS ON EITHER SIDE.

FIG. 2. DOUBLE PYELOGRAM SHOWING BIFID PELVIS ON LEFT SIDE AND KINK IN LOWER END OF RIGHT URETER.

FIG. 3. DOUBLE PYELOGRAM SHOWING BILATERAL HYDRONEPHROSIS AND HYDROURETERS.

FIG. 4. DOUBLE PYELOGRAM SHOWING DOUBLE RENAL PELVIS ON ONE SIDE, WITH STONE IN THE UPPER PELVIS AND A BIFURCATED URETER ON THE SAME SIDE.

The marked degree of fluidity of the solution is of great advantage, for it so rapidly escapes from the kidney pelvis, ureter and bladder that a plate, made a few minutes after the injection has been discontinued, gives no suggestion of a shadow, thus showing that the solution has been completely eliminated from the urinary tract.

That the solution is not irritating to the mucous membranes of the bladder, ureters and pelves of the kidneys has been demonstrated by the fact that no urinary symptoms have been observed in the cases in which it has been used. Subsequent cystoscopic examinations have shown no evidence whatsoever of any inflammation of the vesical mucous membrane; the examination of the bladder, ureters and kidney pelves, in cases which have come to operation within a few hours or days after its use, has shown no evidence of any irritative action. In the animals into whose peritoneal cavities this solution has been

introduced, there has been no sign of any peritonitis at autopsy, and all of the fluid has been absorbed in most instances. The careful neutralization of the solution in its preparation has been emphasized previously, and it is due to this fact that no irritating action has been observed.

The solution, although exerting an inhibitory action on the growth of the ordinary bacteria, is not bactericidal. Moulds grow in it upon standing; therefore, it must be sterilized and kept sterile while being used.

A word may be said in regard to the introduction of the solution into the renal pelvis and ureter. This is done by the gravity method by means of a burette with a rubber-tubing connection and a properly fitting nozzle for the end of the ureteral catheter, the burette being held slightly above the level of the patient. This method is recognized by urologists at the present time as being the least dangerous and most successful for completely distending the renal pelvis. Injection by means of a syringe has fallen into disuse because of the great danger of over-distention of the pelvis, and the forcing of the solution into the renal parenchyma or into the perirenal tissues. In practically all the cases of death reported as due to the use of collargol, this latter procedure was employed.

Since the introduction of the solution into the Urological Clinic of this hospital thirteen months ago, it has been used in two hundred cases without any untoward effects whatsoever having been observed. In the series of pyelograms there was a slight reaction characterized by nausea and vomiting, and a slight rise in temperature following its use, in five cases. These symptoms could be readily accounted for by the ureteral catheterization alone, for they occur fully as frequently in cases where this alone has been done and no injection has been made into the renal pelvis or ureter. In one of these cases, on account of the irritability of the bladder, the patient had to be etherized before ureteral catheterization could be attempted; the etherization could account for the nausea and vomiting in this case. In the series of cystograms it is seen that nausea and vomiting occurred in one case, and slight nausea and frequency of urination in another. In the first case the nausea and vomiting occurred some hours after the cystogram had been made and was due in all probability to some indiscretion in diet. In the second case the patient was quite nervous, this condition probably being entirely responsible for the symptoms.

The largest amount used in the entire urinary tract in a single case was 600 c.c. of a ten per cent. solution introduced into the bladder, ureters and renal pelves of a boy twelve years of age. The roentgenogram in this instance showed a dilated and trabeculated bladder with dilatation of the internal sphincter, double hydro-ureters and hydronephroses, due to a congenital obstruction in the posterior urethra. This patient showed no change in the phenolsulphonephthalein output or blood urea content; nor has there been any interference with kidney function demonstrated in any of the cases. For pyelograms from 5 to 150 c.c. of a fifteen per cent. solution have been used, and for cystograms from 30 to 930 c.c. of a ten per cent. solution.

There is a class of cases in which the phenolsulphonephthalein output for two hours is markedly reduced and the blood urea content well above normal, in which pyelography if attempted at all should be done with extreme care. In these cases any solution injected into the renal pelvis or ureter might sufficiently derange the functional activity of the renal parenchyma to cause the onset of uremia; therefore, if it is felt that a pyelogram is absolutely necessary it should be only attempted on one side, and then an interval of several days allowed to elapse before a pyelogram of the other side is made.

The solution is comparatively inexpensive, being about one-third the cost of collargol.

From the foregoing it is seen that this thorium solution possesses marked advantages over any other solution used for pyelography, and its great value in urology and roentgenology has been fully established.

THE SENSITIZING EFFECT OF COLD ON ROENTGENIZED SURFACES

BY C. AUGUSTUS SIMPSON, M.D.

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WASHINGTON, D. C.

AT present, when the technic of roentgen therapy seems to be on an assured footing, it seems that any clinical data which might have a bearing on this valuable subject is interesting enough to report.

According to Schultz,[1] the radio-sensibility of cutaneous cancers and other skin lesions often plays as prominent a part in the results as the amount of ray delivered to that lesion.

I stated in my third article[2] on roentgen therapy that there will be no better results with the future perfection of machines and tubes but that future advantages would be derived from the working out of a more perfect technic.

Working with this idea in mind, it seemed that dermatologists were on the threshold of the development of a more useful technic, one which might cause some most obstinate skin lesions to undergo resolution more quickly. To realize this anticipated technic depends in a great measure on a more intelligent knowledge of the radio-sensibility of the individual skin lesions and the known quantity and quality of ray that is most readily absorbed, taken up and made use of by each cutaneous disease.

Such a desirable technic would naturally depend very much on the stable and unchanging sensibility of a lesion like psoriasis, for instance. Should the same disease, in the same patient and over the same area, undergo varying degrees of susceptibility, it naturally would be highly dangerous to give any but the mildest and least stimulating doses of ray. Under these conditions, roentgen ray dosage for certain skin diseases would be as uncertain and vague as it was a few years ago.

Many factors have been reported from time to time which have a bearing on the susceptibility of the skin. Age of the patient, area of the body exposed, and local anemia from adrenalin injections are well-known influencing conditions. Dryness or dampness of the skin, alkalinity or acidity of the sweat, local applications of the high frequency currents and cutaneous vasomotor irritability are all mentioned by Codman.[3] Pusey[4] in his book, says that he has never noticed the influence of such factors. Heidingsfeld[5] describes an early and severe radio-dermatitis of the second degree which followed three mild exposures of roentgen ray in a case of dermatitis hiemalis. Most of such reports were before the days of the pastille so it is impossible to know just how much ray was given but I mention Heidingsfeldt's case as it may throw some light on cold as a skin sensitizer. Should the disease, dermatitis hiemalis, or its climatic etiological factor, prove to be a skin sensitizer, it must derive its effect through skin anemia. Considering the climatic influences in the etiology of this disease, a skin lesion often associated with cutaneous dryness and lack of sebaceous and sweat secretion, one is compelled to believe that such an increased susceptibility results from the lack of adequate blood supply and circulation. This theory is quite in line with the suggestion made by some that subcutaneous injections of adrenalin, by producing anemia, have the effect of intensifying all light treatment. The protective action of the circulating

[1] Schultz, "X-Ray Treatment of Skin Diseases," page 89.
[2] "Relative Value of Radium and X-Ray in the Treatment of Skin Diseases and Cancer," *Southern Med. Jour.*, Oct., 1914.
[3] *Philadelphia Medical Journal*, 1902, IX, p. 438.
[4] "The Roentgen Rays in Therapeutics and Diagnosis," page 250.
[5] Cincinnati *Lancet-Clinic*, August, 1902.

blood in normal and congested areas is well shown by the necessity of compression in order to get deep and intense light action from the Finsen and Kromeyer lamps. The above-mentioned known methods of intensifying the effects of light are in contrast to the local action of the irritating high frequency current which, by its congesting effect, gets the benefit of the increased local blood supply which protects the tissues from future roentgen exposures.

In the roentgen ray treatment of 38 cases of exophthalmic goitre by massive

FIG. 1.

doses which I began in 1914, I have seen several instances of the sensitizing effect of applications of cold to the skin. Rest and the wearing of ice bags over the enlarged thyroid have constituted by far the most frequently used non-surgical treatments my patients have employed before undertaking the roentgen ray treatment.

Treatment	*Number of Patients*	*Results*
Rest alone.	19	Temporary improvement in 15 cases, unsatisfactory in 4.
Rest and ice to neck.	4	Temporary improvement in all who persist in the treatment.
Iodin either in ointment or iodid of potash.	4	Every case of exophthalmic goitre made worse.
Beebe's serum.	2	One unimproved, one, disease became worse under treatment.
Thyroidectin.	5	No improvement unless given while patient was taking rest treatment.

Two of the remaining five had all of the above treatments except the serum, one had three operations (excision and ligation) and the other one operation (excision) besides, without the least relief.

From the above, it will be seen that I have had four cases who had used ice applications over the thyroid region and who were still using the ice bag when they took their first roentgen ray treatment. In this way I have had the excitement of seeing four severe skin reactions after delivering as little as 3½ units Hampson, filtered through one millimeter aluminum, the skin being protected from secondary rays by five layers of chamois skin.

In the illustrated case I also exposed the upper thorax in order to take in any possible enlargement of the thymus. Both areas were the same distance from the anode, subjected to the same measured amount of ray, protected by the same thickness of chamois skin besides being exposed simultaneously and in every way getting the same quality and quantity of ray. The reactions, as the accompanying illustration shows, were always confined to those surfaces which were in contact with the ice bag, while the exposed inner clavicular and upper sternal areas, exposed under the same conditions and simultaneously, were perfectly normal, both subjectively and objectively.

In the accompanying case, I anticipated a reaction and gave only 3½ units Hampson filtered ray, two days after which the

reaction began and progressed for five days and was at its present fading intensity two weeks following the exposure. Four weeks after the treatment and with no applications of ice in that interval, I gave five points Hampson under the same conditions with very little resulting redness or irritation. Those who question the efficiency of the pastille may point to this as a proof to the contrary, but the above instance is only one of a number of similar cases which I have had, all following the use of the ice bag, and never yet occurring on any rayed surface but that which has been in contact with the ice. Indeed the ice bag has proved such a skin sensitizer that I allow only those patients to use it who have derived the greatest benefit from it in the past. In such cases I have learned to make allowances for the skin reaction by giving always less than three and a half points Hampson.

As to the reactions there is little to be said. As a rule they begin from two to five days after the exposure. The redness reaches its most noticeable stage on the fourth or fifth day, persists for a week or ten days, when it begins to fade. By the end of two weeks there may be still considerable congestion in which case I allow the third week to elapse before another exposure. I have never seen severe symptoms, as vesiculation or bullous formation, but only a dry, red, congested, slightly sensitive area whose borders outline the location of the ice bag. At the end of three weeks, all that remains of the reaction is a hyperpigmented area resembling the results following a mild sunburn. On this discolored surface the uppermost layers of the skin may sometimes peel off in little islands. There are no signs of tenderness, scar, atrophy or telangiectasis to mark the sites of the previous reaction. It constitutes a radio-dermatitis of the very mildest variety.

I might add that I guard the areas and surrounding parts with lead rubber, with tube stand and table well grounded and that neither the patient nor myself sees or feels any sign of a static spark that might have the slightest bearing on the reaction.

THE X-RAY IN INDUSTRY *

THE roentgen rays during the past several months have been put to many uses—some of them unusual and most of them startling in the light of the marked limitations of the application of rays only a few years ago.

Discovered quite by accident, the rays, since designated in honor of Wilhelm Roentgen, their discoverer, soon found a wide scientific application. Then with the knowledge that they could penetrate opaque material it was but natural that they should find favor with the medical profession for the examination of bones. Later, through improved technic and apparatus, they were used for diagnosing organic conditions and for the treatment of various diseases.

Now, in addition to their medical value the rays have reached a place of great importance in the commercial and industrial field. Nor has their power been overlooked by the scientific detective.

During the past months there have been many cases of thwarted attempts at smuggling wherein the rays have played a prominent part in locating contraband material. One expedient resorted to in shipping rubber across the Atlantic was to pack it in bales of cotton waste. So carefully were the bales made up that to all appearances they were nothing other than they appeared to be. The scheme seemed destined for success until certain bales were selected for *x*-ray examination. Under the penetrating ray a faint shadow was cast on the fluoroscope. The bales were opened, and packed in every 350 pounds of cotton waste

* Reprinted by permission from *The Edison Monthly*, May, 1916.

were found 250 pounds of rubber. In another instance the *x*-ray examination of the personal baggage of a traveler disclosed the presence of mine cases and asphyxiating bombs.

Of a more constructive purpose, however, is the use of the rays industrially in the examination of substances required in the various fields of manufacture. Flaws have been found in steel castings, porousness has been revealed in copper, defects in insulating material have been located, while in the manufacture of cigars the rays are used to kill the destructive tobacco beetle.

Recently a steel casting was received at the works of the General Electric Company at Schenectady. It was two and one-half inches thick and weighed about one ton. During the process of machining down to the desired thickness slight imperfections were disclosed. It was then decided to make an *x*-ray examination of the entire casting. The steel was set on edge, backed by a sheet of lead with a photographic plate between. A Coolidge tube designed especially to carry high voltages was used. Current at 1.25 milliamperes was passed through the tube for each of several two-minute exposures. The resulting pictures located a long flaw. To confirm the *x*-ray finding a disc was cut from the metal at a point indicated on the photograph, and the hole was found just as indicated.

In another test, copper castings were examined. Ordinarily copper castings are full of pores and blow-holes which not only reduce the mechanical value of the metal but result in very low electrical conductivity. This of course is due to the oxidization of the metal. Boron suboxid, a by-product of the manufacture of boron, has the property of deoxidizing copper without combining with it and is now generally used at all copper plants. In the test boronized copper and unboronized copper were examined side by side, the *x*-ray photographs being recorded on the same plate. The pores in the unboronized metal showed clearly while the treated metal showed a solid structure. The photographs were afterwards confirmed by planing down the surfaces of the two castings.

Another striking illustration of the industrial value of *x*-rays is seen in the examination of built-up sheets of mica, which are used for insulation in electric motors and generators. Foreign substances of varying thicknesses make the material useless for this purpose. The ordinary inspection consists of a visual examination and gauging with a micrometer, which at its best is a slow process. Under the *x*-rays all defects may be seen at a glance. The sheets are only .032 inch thick yet a variation of .005 is indicated plainly.

In embryology *x*-rays are used for the study of plant and animal life at various stages of development.

What is probably one of the largest commercial applications of the *x*-ray is at a tobacco factory in Key West. The tobacco beetle larva, which lives on the leaf, is so small that it cannot be seen. If it is not destroyed it develops, becomes active and eats its way through the finished cigar. At the factory in question the cigars are made and packed in boxes, no effort being made to destroy the larva until after the containers have been closed. Then the boxes of cigars are passed through the *x*-rays, the exposure destroying all life without affecting the tobacco.

The phenomena of the rays were discovered in 1895. A period of twenty years has seen their development from a mystery to a scientific agent of inestimable value. It is interesting to speculate on the development in roentgenology that, in response to the demands of commerce and industry, will come with the next twenty years.

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EDITORIALS

DR. PRESTON M. HICKEY

Dr. Preston M. Hickey has completed ten formative years of constructive service as editor in chief of the AMERICAN JOURNAL OF ROENTGENOLOGY. He has seized upon this as the occasion for voluntary retirement from office. In the beginning he had the making of a new and distinctive American Journal committed to his hands. He is now able to turn over to his successor a Journal which is conceded to be one of the foremost in the world of roentgenology.

The discovery of the *x*-ray found Dr. Hickey engaged as a professor of pathology and as a specialist in diseases of the throat and respiratory tract. At this time a wonderful microphotographic outfit was his particular pride. His work in this line showed the same qualities of technical perfection which later characterized his *x*-ray plates. He devised an original method of using stained pathological sections for classroom demonstrations in the place of microphotographic lantern slides. This method was soon widely adopted for teaching purposes.

The *x*-rays at once cast a spell upon Dr. Hickey from which he can never break away. He became one of the earliest pioneers. As a charter member of the American X-Ray Society he laid the foundation stones of the present association. The affectionate term "Pa" Hickey is a recognition of this fact. He has a genius for organization without friction and without failure. In due time he served as president of the society and was then promoted to the editorship of the JOURNAL.

During these years Dr. Hickey's contributions to roentgenological literature, his addresses and demonstrations before medical societies, and his inventions and improvements of apparatus have been unremitting. His office has been a Mecca for roentgenologists who have always found him ready to show them technic and appliances with that combination of frankness and modesty which is the touchstone of the true scientist.

The American Roentgen Ray Society has developed the fraternal spirit to a degree which is as rare as it is beautiful. Within this chosen circle Dr. Hickey finds his best friends. With one accord they extend to him the hand of real fellowship

and assure him that his labors in their behalf on the JOURNAL and in the Society are appreciated now and for all the fruitful years which will yet be his.

* * *

The newly elected editor realizes that the greatest work for our society has already been accomplished, so far as the establishment of its official journal is concerned, but there still remains much to be done if we maintain and still improve the standards set. In this the editor must have the coöperation of every member of the American Roentgen Ray Society. We have already received tangible proof of loyalty from several of our members whose papers read at the Chicago meeting were wanted for publication elsewhere, the members cheerfully and promptly acquiescing in the rule which makes every paper read at the annual meeting the exclusive property of the society to be published in its official organ. New material is needed constantly, especially reports of new discoveries in interpretation and improved methods of technical application of the rays, as well as accounts of rare and interesting proved cases. The new editor undertakes this addition to his labors cheerfully, for he feels assured of full and hearty cooperation on every hand.

THE CHICAGO MEETING

Once again the annual meeting of the American Roentgen Ray Society is a matter of history. The details of the seventeenth annual meeting which has just taken place in Chicago, will be published from month to month in the pages of this journal, but it seems fitting to express in the name of the society our appreciation of the work of the committees on arrangements and program through whose untiring efforts such a feast of mental and social good things was afforded us amid such pleasant and comfortable surroundings. The quiet of the meeting hall was especially grateful to those who remembered the clanging street-cars and other disturbing noises of some of the past meetings.

The program included a number of highly interesting and valuable communications, some of them presenting new matter of far-reaching importance and pregnant with possibilities of future development. The scientific and commercial exhibits were dignified and helpful, as usual. One new feature of the scientific exhibit deserves special mention, viz., demonstrations of photographs, roentgenograms and specimens illustrating a number of pathological conditions of the skeleton, the stomach and the duodenum, and the lungs. The society is especially indebted to Drs. D. B. Phemister, W. S. Miller, and W. C. McCarty for their generous help in preparing and demonstrating these exhibits.

The testimonial banquet tendered by the society to Drs. Henry Hulst of Grand Rapids and Walter Dodd of Boston was a very enjoyable and memorable affair, though its pleasure was marred by the unavoidable absence of Dr. Dodd, who was detained at home by physical ills the result of early exposure to the ray. All joined the speakers of the evening in their appreciation of the work done by both of these pioneers in our chosen field.

More than the usual proportion of the members were accompanied by the ladies of their family, for whose comfort and pleasure the local committee had made ample provision.

TERMINOLOGY

Much confusion could be avoided if all who write and speak concerning roentgen ray work would adopt a uniform terminology. Skiagraph, skiagram, radiograph, radiogram, roentgenograph, roentgenogram, and *x*-ray picture are only a few of the terms which are used in manuscripts arriving at the editor's desk. It is highly desirable that roentgenologists should devote special effort to the adoption of the standard terminology both in their writings and in their daily speech. Roentgen called

his discovery the "*x*-ray," but the civilized world has seen fit to designate this wonderful ray by a special name in honor of the discoverer, and the name Roentgen has entered into the literature of all countries, including our own. Since the beginning of the great War the term Roentgen has become distasteful in certain quarters and an effort is being made to revert to the older terminology. Our greatest American medical periodicals, such as the *Journal of the American Medical Association*, *Surgery, Gynecology and Obstetrics*, and the *Annals of Surgery*, have adopted the terminology which was given full approval by the American Roentgen Ray Society at its annual session in Boston, in 1914. Appended will be found a list of the more important words relating to our specialty, which our members are urged to use, not only in writing, but in their daily speech.

The employment of the phrase "*x*-ray picture" is only more or less natural for the layman, but it should not be for the physician, especially one who practices roentgenology. Roentgenograms are not pictures in the ordinary sense of the word, and roentgenology in its most valuable application to internal medicine is not a matter of roentgenograms or so-called "*x*-ray pictures." Hence the employment of the term "*x*-ray picture" only serves to perpetuate an erroneous idea. While technical knowledge and practical experience are required for mechanically perfect roentgen ray work, the real work of the physician who specializes in roentgenology does not begin until the image has been secured, and his work is therefore not in any but a small sense a photographic labor. It would be helpful if all physicians would discourage the use of this and allied crude terms, and adopt the standard terminology which has the unanimous approval of our national roentgen society and the editors of our prominent medical periodicals. Some of the more important words relating especially to roentgen work are included in the following list:

Roentgen—pronounced rent gen.

Roentgen ray—a phenomenon in physics discovered by William Conrad Roentgen.

Roentgenology—the study and practice of the roentgen ray as it applies to medicine and surgery.

Roentgenologist—one skilled in roentgenology.

Roentgenogram—the shadow picture produced by the roentgen ray on a sensitized plate or film.

Roentgenograph—(verb) to make a roentgenogram.

Roentgenoscope—an apparatus for examination with the fluoroscopic screen excited by the roentgen ray.

Roentgenoscopy—examination by means of the roentgenoscope.

Roentgenography — the art of making roentgenograms.

Roentgenize—to apply the roentgen ray.

Roentgenization—the application of the roentgen ray.

Roentgenism—untoward effect of the roentgen ray.

Roentgen Diagnosis—diagnosis by aid of the roentgen ray.

Roentgenotherapy—treatment by the application of the roentgen ray.

Roentgen Dermatitis—skin reaction due to too strong or too oft repeated application of the roentgen ray.

TRANSLATIONS & ABSTRACTS

PAUL KRAUSE. On the Technic of Searching for Bullets, and a Roentgenographic Measuring Method without Apparatus. (*Berl. klin. Wchnschr.*, April 3, 1916, p. 362.)

Krause, who serves as a military surgeon at the German front, has used a short furlough to chronicle his experience in the search for, and removal of, bullets. He has been diligently engaged on the subject of locating foreign bodies by measurement with the aid of the roentgen rays for twelve years. The mathematical problem of roentgen measurement is much simpler than that of ordinary photometry, and the various roentgenometrical apparatus have merely been devised as a substitute for mathematics to which physicians do not take kindly. The author, too, constructed an apparatus designed to meet all requirements, but as this was an expensive affair, he refrained from putting it on the market, being convinced that the same object could be obtained much more economically. He then set to work to devise a mathematical method which, having stood the test of war and private practice, is now communicated for publication.

There is no need for roentgenometry to locate any and every foreign body, and this is fortunate because war conditions do not lend themselves to it. The still fresh traumatic canal, the demolished tissue, the discoloration and swelling of skin areas in the neighborhood, facilitate the discovery and removal of bullets.

In the application of the author's roentgenometric method, it is necessary to make two exposures vertically upon each other. The local and the roentgen findings must correspond. If the bullet is in or near a bone, this method is preferable to deep measuring. When the bullet is wedged in between thick muscle masses, neither of these methods is reliable. The decrease of tension caused by the mere skin incision is sufficient to dislodge the foreign body. The soft musculature assumes a different position and the measurement no longer agrees. The simple plan of inserting two hollow needles into the region of the bullet in deviating directions is better. After that, two exposures vertical upon each other will accomplish the desired object. Only for the removal of bullets of small calibre has the author occasionally operated with the aid of the fluorescent screen. Although this should be done on a Perthes table, an improvised device will answer the purpose, especially as these cases do not happen frequently. Protection from the roentgen rays may be left to the operator to select as best he may. The author has managed with thick rubber gloves, a lead apron and leadglass spectacles.

In home hospitals, the majority of cases require the removal of healed in bullets, and as there are generally no urgent indications, the location of the bullet is roentgenologically determined and marked upon the skin. The mathematical principle observed is appended at the end of the author's article in order to meet the wishes of those interested in such matters.

The only measuring instrument required is an equilateral triangle of 8 cm. length, which is easily cut from a sheet of lead. This is suspended by a thread at the apex, and the thread is allowed to hang vertically under the focus down to the skin. The triangle is fixed to prevent its spinning.

The general survey exposure will serve to indicate in a general way the location of the bullet and the direction from which the attack has to be made.

For measuring purposes, the patient is placed in the same position he will occupy at the operation. The triangle is allowed to descend until it touches the skin. The line in which it does so is deftly marked on the skin (washing of the skin with ether, etc., marking with pyrogallol, silver nitrate). The distance of the tube from the plate is immaterial, but it should not be excessive in order to facilitate the measuring of the two exposures on one plate.

In the first exposure, the triangle is shown on the plate as a straight line of a certain length. If it is broader than a mere line, the centration has been wrong.

The second exposure is made with the tube at any desired distance, say 10 cm. The straight line representing the triangle will then appear on the plate by as many centimeters distant from the first as the tube was shifted. Thus, there will be on the plate two line pictures and two bullet pictures. The base of

the triangle is slightly notched, which will be shown on the plate as the centre of the two lines. The two lines on the plate are connected with the identical points of the corresponding bullet pictures. The fact that they are the corresponding pictures is seen by the two lines intersecting (Fig. 2). Nothing more is to be marked on the plate. The point of intersection of the two lines is the so-called base point of the bullet, i.e., vertical above or below it at a certain distance will the bullet be found. It is now left to determine where the base point is on the skin and how far below or above it is the bullet. The latter is, of course, shown by the distance of the two bullet pictures from each other. This as well a the other constant values are determined either by drawing or calculation, in so far as they can be measured direct with a foot rule or a plumb

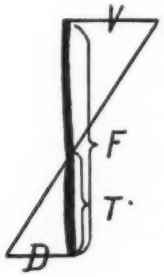

FIG. 1.

line. The technic involved does not go beyond the knowledge of a fairly advanced schoolboy.

The constant values are:

(1) F—Focus-plate distance (measurable with plumb line);
(2) V—Shifting distance of the focus (measurable at the stand);
(3) p′ and p″—the two centre points of the projection;
(4) D—Distance of the two bullet pictures (measurable on the plate);
(5) T—Depth of the bullet (to be calculated).

The depth of the bullet is determined first. For this purpose, write on the triangle the formula

$$T = \frac{D \times F}{V + D}$$

If drawing is preferred to calculating, draw a line the length of F cm. (focal distance), draw at one of the end points a vertical line the length of V cm. (focal displacement), and at the other end point in the opposite direction a line the length of D cm. (distance between the two shot pictures). Connect the two end points of V and D. This connecting line intersects F at a point which will indicate the desired distance of T from D (plate plane), (Fig. 1).

The next thing to determine on the skin is the point, under which the bullet lies vertically. Start from the line which was drawn first on the skin. This principal line corresponds on the plate to the line P′, with the centre point at p′. Measure on the plate (Fig. 2) the distance from p to s and the angle between P′ and that distance. Mark this distance on the skin; also the same angle from the lines drawn on the skin and the marked centre

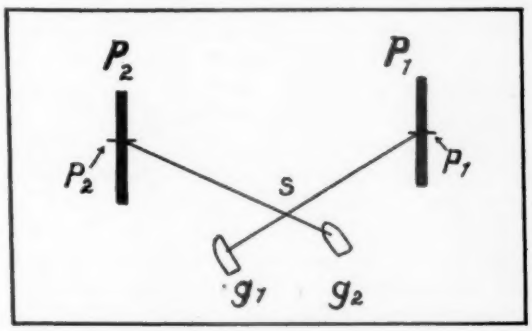

FIG. 2.

points in the direction indicated by the plate; to the left or right, up or down. The transfer of the angle is of course to be done in the horizontal plane of the line on the skin. Vertically below the point of the angle, the bullet will be found. The depth of the bullet is measured from below upward. If it is desired to measure the depth from above, it is necessary to start from the line on the skin, the elevation of which above the plate is a known factor, the triangle being suspended at a measurable distance above the plate. The difference shows the distance from above.

The mathematical explanation of this simple measuring method is the following:

The length of D (distance of the bullet pictures) is only dependent on the general height of the bullet above the plate, the shifting of the focus and the focal distance. Wherever the bullet may be located, D is always unchanged, as long as FV and T remain unchanged. A

simple experiment will explain this. If the shadow of a horizontal rod is cast on a horizontal plate, the rod or the source of light may be moved anywhere in a horizontal plane without the length of the shadow being changed. This is due to the proportionality of all resulting triangles which are composed of the point of light and the end points of the shadow lines.

For the sake of simplicity, it has been assumed in the illustration that the bullet lies vertically below the focus in the center ray. The first illustration will show that two similar triangles have resulted, the heights of which

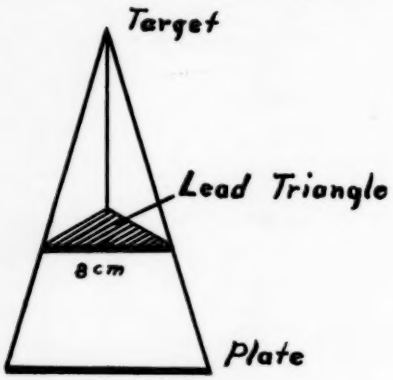

FIG. 3.

(T and F − T) are proportionate to the base lines V and D; hence the equation

$$D : V = T : F - T \text{ (Fig. 1).}$$

In this equation, T is the unknown value. Working out the equation, it is found that

$$T = \frac{D \times T}{V + D}$$

It is further to be proved that the point of intersection s of p′ and p″ with the two bullet pictures g′ and g″, is the base point of the bullet which means that it is vertically above or below the bullet.

p′ and p″ are the base points of the centre ray on the plate in the first and second exposures, because the centre of the triangular base was suspended vertically under the focus (f′ and f″, respectively). Consequently, f′ g′ p′, and f″ g″ p″, are rectangular triangles intersecting in the line T (depth line) of the bullet or having that line in common. As this line is parallel to the centre ray, it must also stand vertically to the plate, i.e., the intersecting points of p′ g′ and of p″ g″ is vertically below the intersection. It is the desired base point.

The lateral deviation of the bullet from P′ is, of course, the same in any plane parallel to the plate, i.e. in any horizontal plane—in the plate plane as well as the bullet plane or the plane of the line on the skin. Consequently, the angle can be transferred from the plate plane to the horizontal plane of the skin line.

If it is not desired to measure the focal distance with the plumb line, but to determine the distance of the focus in the interior of the glass globe from the plate (which has advantages when very exact measurement is required), the lead triangle is again the appropriate means.

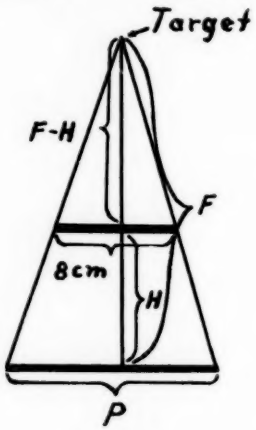

FIG. 4.

The base of the triangle appears larger as compared to the length of P′ on the plate, the nearer the focus and the triangle are together. Here is the proof: The shadow of an object grows larger as it is approached to the source of light, and smaller as the distance is increased.

It is possible, therefore, to calculate the focal distance from the measure of enlargement of the triangle, as soon as the distance of the triangle from the plate is known. This distance can be measured with the foot rule after the patient has been removed from the cassette (Figs. 3 and 4).

In the resulting two similar triangles, the base lines (P′ plus 8 cm.) are proportional to the corresponding heights (F and F − H); hence the equation $P : 8 = F : F - H$. H is the elevation of the triangle above the plate, F is the unknown value. Worked out,

$$F = \frac{P' \times H}{P - S}$$

This method is so simple that the author's nurses can use it after a single explanation.

DE QUERVAIN, F.: Diverticulum Formation in the Stomach. (*Mitt. a. d. Grenzgeb.*, Vol. 28, No. 4, 1915. Ref.: *Zentralbl. f. Roentgenstrahlen*, Vol. VI, Nos. 9 and 10, 1915.)

Report of two cases with both roentgenological and clinical findings. Roentgen findings: (1) The excavation belongs to the stomach because it fills simultaneously with it; the residue shadows in the diverticula are independent of the intestinal shadows. (2) The excavation maintains a constant position to the vertebral column; it changes in regard to the stomach, appearing at the lower gastric border when the stomach is elevated in a nearly empty condition, and at the upper gastric border when the stomach descends in a filled condition. (3) The bulging can be seen in all the roentgenograms and therefore seems to be of a constant nature. A confusion with Haudek's niche is not very likely.

MÜHLMANN, ERICH: Contracted Stomach due to Syphilis. (*Deutsch. med. Wchnschr.*, 1915, No. 25, p. 733. Ref.: *Zentralbl. f. Roentgenstrahlen*, Vol. VI, Nos. 9 and 10, 1915.)

A diagnosis of syphilis of the stomach is justified when the Wassermann reaction is positive and the stomach is small and contracted. The author warns against confusion with scirrhotic (carcinomatous) shrinking. The Wassermann test is usually decisive, but the roentgenological examination differentiates between the shapes of the carcinomatous and syphilitic contracted stomach. In the former, there are indistinct contours, pictures suggesting defects, while in syphilitic stomachs the contours are rather smooth. Chronic sclerotic gastritis, following interstitial gastritis, with atrophy of the glands, fibrous transformation of the mucous membrane usually with preserved epithelium, should likewise be taken into consideration.

PONZIO, M.: Roentgen Diagnosis of Perforating Gastric Ulcer. (*R. Accademia di Medicina di Torino*, May, 1914. Ref.: *Zentralbl. f. Roentgenstr.*, Vol. VI, Nos. 9 and 10, 1915.)

The lecturer demonstrated a series of twelve roentgenograms of single and double perforated gastric ulcers, discussing the value of the roentgenological examination in the diagnosis of such lesions. The presence of a perforating ulcer of the stomach is revealed roentgenologically by a more or less broad pedunculated or nonpedunculated diverticu um which, in the majority of cases, is located in the upper third of the lesser curvature. Upon administration of bismuth milk, a large dark spot the size of a pea to that of a hen's egg is observed by the side of the gastric shadow. Occasionally, there are several diverticula. The stomach usually shows a distinct constriction at the level of the ulcer. When the ulcer is adherent to the neighboring organs, especially the liver or the pancreas, the diverticulum may descend into these organs and assume the character of a penetrating ulcer. In such cases the niche appears larger and contains three superimposed layers: bismuth, liquid and air. This is still visible on the screen after complete evacuation of the stomach. Occasionally, it will then appear separated from the gastric shadow, because the short canal connecting the same with the gastric cavity is not visible. It is necessary to apply roentgenoscopy in various directions in order to study the lesion in all its relations.

KOERNER, O.: Traumatic Hematoma of the Mediastinum with Considerable Displacement of the Esophagus and Trachea, but without Paralysis of the Recurrens. (*Zeitschr. f. Ohrenh.*, Vol. 73, 1915, No. 1, p. 33. Ref.: *Zentralbl. f. Roentgenstr.*, Vol. VI, Nos. 9 and 10, 1915.)

About five days after a serious contusion of the thorax in a soldier, there was difficulty in swallowing which the patient referred to the esophagus. The differential diagnosis was between traumatic aneurysm of the aorta, traumatic diverticulum of the esophagus and hematoma. On the ground of the roentgenogram traumatic hematoma was decided upon.

BALLI, R. and CAPPONI, F.: The Structure of the Patella. (*La Radiologia medica*, 1914, Nos. 10 and 11. Ref.: *Zentralbl. f. Roentgenstr.*, Vol. VI, Nos. 9 and 10, 1915.)

The authors have made radiological examinations of the patella of 58 individuals of varying ages, and arrive at the following conclusions:

Anterior Wall, Lateral Roentgenogram.—In children, commencing with the age of 7, the patella becomes visible in the shape of a delicate stripe of uniform thickness, running a vertical course. In adults, it is a compact tissue layer,

usually thicker in the region of the base and gradually thinning toward the apex. Occasionally, it is thickest in the middle, becoming attenuated toward the base and apex. It is rarely of uniform thickness throughout. Least frequent is the greatest thickness at the apex, and the least thickness at the base. The fibres of which it is composed are arranged in the direction of the vertical axis. They are not uniform in density along their entire course; they are denser in the middle, less dense at the base and least dense at the apex. Sometimes, the fibres are arrested before reaching the apex, the latter being then formed of spongy tissue. Occasionally, some fibres of the compact tissue of the anterior wall in the region of the base and apex run obliquely and backward in the direction of the body of the patella. In other cases the fibres in the apical region of the anterior wall radiate, participating in the formation of the apex tissue. In old individuals, the observations are more or less the same, except that the compact tissue is sometimes less thick.

Anterior Wall, Vertical Roentenogram.—In children, commencing with the age of 7, the anterior wall becomes visible in the shape of a short stripe of compact tissue which does not extend to the edges. In adults, the anterior wall of the rotula consists of a layer of compact tissue which is thickest in the central region of the wall. Sometimes it is thickest in the outer third of the wall, less often in the inner third or inner half. The compact tissue is formed of osseous fibres, usually arranged in the direction of the transverse axis of the rotula and densest in the middle section, gradually exhausting themselves near the edges. The compact tissue layer, forming the anterior wall, sometimes shows a series of undulations. The fibres forming this layer often run an oblique course. The findings in older individuals show but slight variations.

Posterior Wall.—In childhood, the posterior wall is not visible. It appears toward the age of 16 as a thin layer of compact tissue, growing somewhat thinner along the outer articular surface and disappearing near the edges. In adults, the posterior wall of the rotula consists of a layer of compact tissue which is always thinner than that of the anterior wall, becomes quite thin at the level of the crista and sometimes even totally disappears, making room for sponge tissue. It is usually thickest at the level of the middle of the outer articular surface, while at the level of the middle of the inner articular surface it is a little less thick. In some cases the compact tissue is found only along the outer articular surface. Not infrequently fibres emanate in front of the compact tissue of the posterior patellar wall, more often at the level of the middle of the outer articular surface, running in the direction of the transverse axis of the patella and diverging fan-like at the edges of the patella. In older individuals, the entire posterior wall of the patella may consist of spongy tissue, though this is rarely the case. Besides, this may also be the case in young individuals.

Margins.—In children, the margins consist of spongy tissue. In adults and very old people the margins (outer and inner) usually consist of spongy tissue, the meshes of which are arranged in the direction of the antero-posterior axis of the patella. Sometimes, however, the margins consist of compact tissue, in which case the fibres of the anterior wall run backward and, reaching the forward fibres, either continue with the latter or cross the same.

Base.—In childhood, the base of the patella consists of spongy tissue. In isolated cases, compact tissue commences to develop as early as the tenth year. In old and very old people, the anterior half of the base usually consists of compact tissue continuing into that of the anterior wall, while the posterior half is formed of spongy tissue, the elongated meshes of which run parallel to the antero-posterior axis of the patella. It is seldom that the entire base consists of spongy tissue.

Apex.—The apex of the patella in childhood is formed of spongy tissue. In adults and very old people the anterior part of the apex is usually formed of compact tissue, the posterior part of spongy tissue with osseous fibres emanating from the lower part of the patellar crest and running downward and forward. Sometimes the apex is formed of spongy tissue exclusively, in rare cases of compact tissue exclusively. Not infrequently the trabeculæ of the anterior and posterior walls cross each other in the region of the apex.

Corpus.—In both children and adults, the corpus of the patella, projected either vertically or laterally, always consists of spongy tissue, whose osseous trabeculæ are intertwined in more or less dense meshes, usually arranged in the direction of the postero-anterior axis of the patella. In the lateral projection, the

meshes in the apical region are preferably directed downward and forward. In very old people, the spongy tissue usually shows more pronounced areolation than in the young.

All this refers to male individuals only.

SCHOENFELD and SORANTIN: Total Absence of Fibula. (*Fortschr. a. d. Geb. d. Roentgenstrahlen*, Vol. XXII, No. 6, p. 616.)

This case concerns a young man of 22 years with no other anomalies. Nor does he know of any anomalies in his family. The case is of interest because, owing to the absence of the fibula, the os trigonum—an otherwise insignificant sesamoid bone—has assumed an extraordinary size. It is located in the angle between the tibia and calcaneus, is kidney-shaped, and has no direct connection with any of the neighboring bones.

BALLOWITZ, E.: Bilateral Symmetrical Heptadactylism. (*Münch. med. Wchnschr.*, Vol. 62, No. 47, Nov. 23, 1915, p. 1605.)

This case is mentioned on account of the rare regularity in the formation of the supernumerary toes and of the latter exceeding six. There were two large toes at each foot, joined together along their entire length with the exception of a slight notch at the tip. Each big toe had a separate, well-formed nail, the two nails growing close together. The next two toes were of about equal length and joined together to about the middle, a furrow showing the syndactylism. The remaining three toes were entirely separate from each other with one nail each, not differing from normal toes. There were only slight differences between the right and left foot.

Inspection and palpation suggested that there was a duplication of the big toe and also of the next toe, while the roentgen examination disclosed the fact that there was one strong metatarsus from which grew two separate big toes, presumably in a common articulation. The skeletal parts of both big toes were about equally developed, and there was no multiplication of the phalanges. The second, third and fourth metatarsals were of ordinary appearance roentgenologically, while the fifth was cleft posteriorly, the rami diverging distally. This divergence caused the very considerable width of the anterior part of the feet, the transverse measurement at the capitulum of the metatarsus being 14 cm. The head of each ramus terminated in a well-developed toe, the medial and nail phalanges being adherent. There was a hereditary taint in the family.

SCHUELLER, ARTUR: Peculiar Cranial Defects in Young Individuals. (*Fortschr. a. d. Geb. d. Roentgenstr.*, Vol. XXIII, No. 1, p. 12.)

This is a description of three comparatively rare cases of cranial defects. The first concerns a boy of 16 years of age with multiple defects of the left cranial hemisphere. There is general dwarfism. Probably there is an angiomatous tumor emanating from the cerebral base. The second case is that of a 4-year old girl with eight cranial defects. Pronounced exophthalmos. Diabetes insipidus. There is probably an affection of the hypophysis. The third case is that of a 7-year old girl with a cranial defect the size of a silver dollar, probably of osteomyelitic origin.

STAEHELIN: Injuries in Winter Sports. (*Beitr. z. klin. Chir.*, 1915, No. 2, p. 237. Ref.: *Zentralbl. f. Roentgenstr.*, Vol. VI, Nos. 9 and 10, 1915.)

The author writes on sport injuries observed during the winter of 1913–14:

In skating, the most requent injury is fracture of the radius, usually consisting of a transverse fracture 1 to 1.5 cm. above the distal end. Another typical injury in this sport is a fracture of the olecranon which is usually indirect. Rarer injuries are fractures of the neck of the humerus, clavicula and patella.

In hockey and bandy (which is an older form of tennis), there are less typical forms of injury, except perhaps occasional injuries to the face.

Typical injuries in "skeleton driving" (coasting) are direct and indirect fractures of the ribs and dislocation of the end phalanx of the little finger. The head, too, is in danger, but serious injuries are rare, as only skilled sportsmen are allowed to indulge in this sport.

In sliding, there occur typical spiral fractures of the metacarpal bones, the line of fracture of one bone extending into the next. A transverse fracture of the humerus is less frequent. Far more so are the fractures of the lower extremities, such as isolated tibial fractures, spiral fractures of the tibia and fibula,

fractures of the malleoli, isolated fractures of the fibulæ. Dislocations are rare. Contusions and distortions, especially of the knee-joint, are frequent. Spectators are also exposed to injuries in this sport, as is shown in a case cited by the author.

Among the injuries in skiing mention is first made of injuries due to the points of the skis. Fracture of the basal phalanx of the little finger and a torsion fracture of the humerus have been observed. Here again, fractures of the lower extremities are far more frequent, especially spiral fractures of the lower leg. The most frequent fractures occur at the external malleoli. Contusion and distortion are likewise of frequent occurrence in this sport. Luxation of the upper arm has been observed only once.

ROST, FRANZ: A Contribution to the Doctrine of Surgical Obstipation and its Surgical Treatment. (*Mitt. a. d. Grenzgeb.*, Vol. 28, No. 4, 1915. Ref.: *Zentralbl. f. Roentgenstr.*, Vol. VI, Nos. 9 and 10, 1915, p. 353.)

This is a survey of the normal physiology of the movements of the colon and the act of defecation, so far as obstipation is concerned.

(1) Obstipation due to disturbed defecatory function (proctogenous obstipation, dyschezia) is caused by:

(*a*) Deformities, mechanical obstacles in the region of the rectum or neighboring intestinal parts.

(*b*) Hypertonicity or spasm of the sphincter.

(*c*) Disorders in the motility of the lower colon or its auxiliary apparatus which may also be a reflex disturbance of the sensitive tracts.

These groups often occur combined and are discussed thoroughly. In proctogenous obstipation there may also be considerable fecal stasis in the proximal colon, in which case obstipation will not be removed by resection of the cecum.

(2) The spastic form of obstipation usually has its seat in the intermediary or distal colon. The fecal stasis in the proximal colon is again really secondary, caused by the resistance of the distal intestinal parts. Since the general symptoms in this form of obstipation are explainable in part by the resorption of toxic substances in the proximal colon, this complaint will be improved by resection of the proximal colon. It depends on the extent of the spasm whether the obstipation will be cured by the operation. The fact of the feces entering the transverse colon in a liquid condition after the operation may lead to an improvement of the spasm, but unfortunately this is not always the case.

(3) Obstipation due to mechanical obstacles:

(*a*) Abnormal course of the peritoneum.

(*b*) Stretching of the serosa (serosa veil) in increase of size of the proximal colon.

(*c*) Pericolitis.

For all these structures, the axiom holds good that obstipation is the primary condition, adhesions or inflammations of the serosa the secondary. All these structures may again be the cause of a fecal stasis.

(4) The forms of obstipation with fecal stasis in the proximal colon do not belong to any of the forms described, although there is also a disproportion between the power of the proximal and the resistance of the distal colon. The cause of this disproportion was examined at autopsy in two cases. The entire colon being microscopically examined, it was found that there was a relative hypertrophy of the proximal and an atrophy of the intermediary and distal colon, from which it follows that the real seat of the obstipation in these cases was not the proximal, but the intermediary or the distal colon.

Hypertrophy was also demonstrated in resected ceca in these forms of obstipation. The seat of the complaints is the proximal colon, and they disappear with its removal, although the cause of the obstipation is not removed. Whether the obstipation is improved by this operation, depends upon the degree of insufficiency of the intermediary and distal colon.

(5) In this form, the disproportion between power of the proximal and resistance of the distal colon is but little disturbed. The resistance is not demonstrably increased, but the proximal colon has no reserve power to fall back upon. It is apt to fail even under slightly unfavorable conditions (cecum mobile, adhesions, inflammations, etc.). In such cases it is usually sufficient to remove the clinical disturbance (cecopexy, breaking up of adhesions) in order to overcome the cecal stasis in the proximal colon. Inasmuch, however, as it is difficult to appreciate the degree of insufficiency, it is advisable even in these cases to resort to elimination of the proximal colon.

WACHTEL, HEINRICH: Instrumental Determination of the Erythema Dose. (*Fortsch. a. d. Geb. d. Roentgenstr.*, Vol. 23, No. 3, Oct. 12, 1915, p. 248.)

This is a suggestion to establish a simple way for determining the limits of a single application of the roentgen rays. Such a method has become necessary since with the improvements in the technic, harder and ever harder rays are produced and used, to which the former erythema figures are no longer applicable. It is therefore apparent that the number of H's and x's, etc., indicating the superficial dose, indicate nothing about the erythema dose. The author believes to have discovered a simple method of determining whether the erythema border has been reached or not. After illustrating his method by numerous theoretical calculations, he comes to the conclusion that "the erythema dose may be determined as absorption in a thin absorbing substance. In doing so, the measurement of the administered quantity of light and its hardness makes no difference in the utilization, but it does in the effect produced. The application of the rays is simply continued until the difference between an uncovered test substance of any desired radiometric method and another substance covered with 1 mm. aluminum amounts to a certain empirically determined figure. When it does so, the erythema dose is reached, and it follows that the application should be interrupted before that figure is reached."

JAWORSKI, W.: Roentgenological and Clinical Gastric Findings Compared. (*Deutsch. med. Wchnschr.*, 1915, No. 37, p. 1088. Ref.: *Zentralbl. f. Roentgenstr.*, Vol. VI, Nos. 9 and 10, 1915.)

The results of physical examinations in the horizontal position are so radically different from radiological findings in the erect position that they can not be compared with each other. If both examinations are made in the horizontal position, the opaque meal being taken erect, the results are only in exceptional cases comparable, and the radiological border of the stomach is always higher than that found in the physical examination. The same refers to Traube's space. The horizontal roentgenological stomach will only in exceptional cases contract around the opaque meal in such a manner as to assume its usual radioscopic elongated shape. Usually the paste collects in the highest part of the fundus below the left half of the diaphragm in the shape of a cone. In some cases it divides, the larger portion collecting in the fundus and the smaller in the antrum. They are separated by the vertebral column. If the patient takes the paste standing and radiography is applied horizontally, the stomach will in most cases appear contracted around the paste, retaining even in the supine position the well-known radioscopic shadow.

When such was not the case in some of the patients under observation, it was due to atony of the stomach.

The examinations likewise admit of the conclusion that the pressure of the paste, taken while standing, upon the lower wall of the stomach incites the contraction of the gastric walls around the paste, while in the horizontal position this incitation is absent.

For the purpose of obtaining results for a clinical diagnosis, it must still be considered axiomatic that the radiological examination of the stomach is most efficiently done in the erect position, and the physical examination in the horizontal position. A direct comparison of the findings is impossible, and other ways must be found to have the interpretation of both methods coincide.

In order to arrive at a tangible clinical result, the author has during the past two years made two diagnoses in each of about 150 cases of gastric affections, one radiological and one clinical, in such a way that each of these patients was radioscopically examined either before or after the clinical examination, and a radiological diagnosis made. From the clinical research, the clinical diagnosis was made. This led to the following conclusions:

(*a*) The ordinary clinical examination yields many more data apt to facilitate the diagnosis and to avoid errors in diagnosis.

(*b*) The radiological examination furnishes in many cases unexpected details of decisive value in the diagnosis; in most cases, the radiological findings are confined to few details admitting of but incomplete diagnoses and often giving rise to errors.

(*c*) The radiological examination of the stomach is the most convenient for the patient and the shortest for the physician; in important disorders of the stomach it should never be made the sole basis of a diagnosis, but should

always be used in conjunction with a clinical examination.

(*d*) In all gastric affections where the clinical examination is doubtful and an anatomical lesion is suspected, the radioscopic examination should never be omitted, because both methods supplement each other.

It will still require many years of arduous toil to clear up and reconcile the findings of both methods with each other.

The author also communicates interesting details on the displacement of the heart due to a filled stomach.

SALZER: Roentgenological Localization of Foreign Bodies in the Eye. (*Münch. med. Wchnschr.*, Vol. 62, No. 50, Dec. 14, 1915, p. 1719.)

The author claims that all the existing methods and instruments for locating foreign bodies in the eye, including the latest methods of Sweet and Holm, are unable to determine the most important question: whether the foreign body is inside or outside the bulbus. The most useful result for practical purposes is obtained by Duken's orthodiagraphic method. By continuous turning of the head, movement of the eyes in various directions, digital pressure upon the lids and bulbus, it is nearly always possible to distinguish whether the foreign body is in the bulbus or not. The operator must possess very perfect visual acuity and be absolutely adapted to dark room work. The employment of plates in two directions, assisted possibly by Wessely's prothesis, will then furnish further guides. Even with this method there are difficulties when the foreign body is located longitudinally in the covering membranes of the bulbus, and this difficulty will not be overcome by any apparatus as long as the sclera can not be demonstrated roentgenologically.

The author also suggests that too much stress has been laid upon the dangers attending healing of eye injuries without removal of the foreign body.

HOLZKNECHT and WEISSENBERG: Contribution to the Technical Measurement of Roentgen Rays. (*Fortsch. a. d. Geb. d. Roentgenstr.*, Vol. 23, No. 3, Oct. 12, 1915, p. 257.)

For the technical improvement of therapeutic light it is necessary to have good physical methods of testing the same. The methods so far in use are considered insufficient by these authors, who proceed to enumerate the drawbacks of the various apparatus and instruments in use. At the same time they propose a new arrangement consisting of a selenium intensimeter and an ebony model, the details of which should be read in the original.

MAYER, ROBERT: The Practical Application of Selenium Cells. (*Fortschr. a. d. Geb. d. Roentgenstr.*, Vol. 23, No. 3, Oct. 12, 1915, p. 283.)

It is a well known property of selenium cells to change their electric resistance when submitted to light rays, and the fact is also known that this decrease of resistance occurs in a certain proportion to the applied intensity of light. Mayer explains the precautions necessary to observe, under which selenium cells in the Fürstenau method may be used as a sufficiently exact and very rapid method of testing the intensity of light.

WACHTEL, HEINRICH: The Finer Details of Fracture Roentgenograms: Diagnosis and Treatment. (*München. med. Wchnschr.*, Vol. 62, No. 46, Nov. 16, 1915.)

The calcareous callus appears in the roentgen negative in the form of whitish, irregular, structureless clouds. In the next stage of healing it becomes diffuse, intensified, and fuses the structures of the fracture into a whole. This, however, does not complete the healing process. The callus obtains a structure in accordance with the function of the fractured place which is distinctly visible in the roentgenogram. This completes the functional efficiency of the bone.

Infection of the fracture will interfere with callus formation. The callus cloud keeps close to the bone. Isolated bone splinters show no callus at all, turning to loose sequesters. When many bone splinters become sequestered, long osseous defects will result. In most cases, however, a callus bridge will result which, running through the various callus stages, fulfills the function of that part of the bone. The remainder of the callus and the adjacent bony parts become eburnated, forming within the callus a sequestered cavity as is observed in the post-traumatic osteomyelitis of war fractures.

The surgical indications follow from the correct interpretation of the pictures, and consist in the following guiding points:

(1) As long as the first callus clouds persist, the fracture can be set without operation.

(2) The fracture will not form a completely closed callus. There may be no callus at all at some fragments and splinters, while it is already quite substantial at other splinters. If suppuration interferes with healing, incision and evacuation are indicated.

(3) The callus is dense, sharply demarcated and structured. Setting without operation is out of the question. (The fracture has healed with dislocation, but with a functionally efficient callus.)

(4) The fracture has healed leaving post-traumatic osteomyelitis in the callus with sequestration. Sequestrotomy is indicated.

(5) The suppurative osseous defect is not spontaneously bridged over as a rule. There is osteomyelitis pseudoarthrosis.

These represent the most frequent observations and indications based upon the condition and healing process of fractures in the roentgenogram.

RIEDER, H.: Shot Wounds of the Lungs and Pulmonary Tuberculosis. (*Münch. med. Wchnschr.*, Vol. 62, No. 49, Dec. 7, 1915, p. 1673.)

Lung shots so far as they have come under observation in home hospitals are considered relatively benign, as the projectiles, especially rifle bullets, often pass smoothly through the lungs or heal in, without causing any considerable tears of the lung tissue and vessels. But there is always hemoptysis even when the pleura has not been injured. This and the shock may be the only pathological signs. Projectiles have often been roentgenologically located in the lungs, of which the patients were blissfully ignorant. Direct injury to the lungs by shrapnel or Russian infantry bullets may cause increased hemoptysis or hematothorax, but the effusion is usually rapidly absorbed and the pulmonary trauma undergoes rapid healing under efficient care. These injuries have therefore come to be considered too lightly. They may often be followed by serious sequelæ such as skin emphysema, pneumothorax, pneumonia, pulmonary emphysema, pleurisy (serous and purulent exudates), callosities, restriction of the thorax. In these cases the function of the lungs may be permanently impaired.

The consideration of the development of pulmonary tuberculosis after shot wounds has been neglected. But the traumatic origin of pulmonary tuberculosis by contusion of the lungs, fracture of the ribs, tearing of the lungs, etc., in healthy individuals without even latent tuberculosis, is an unproved assertion, and the term of "traumatic tuberculosis" in the sense of Brehmer, Jacob and Pannewitz, Mendelssohn, is unjustified. It may be conceded, however, that the resistance of the injured lung to tuberculous infection is reduced. The assertion that a traumatic infection of the lungs may lead to immediate development of (traumatic) pneumonia and subsequently to tuberculosis in a soil prepared by blood and laceration, likewise lacks confirmation.

But there can be no doubt that a tuberculous affection of the lungs, whether latent or manifest, is exacerbated by an injury to the thorax. A latent or inactive tuberculosis may develop into an active, a closed into an open one.

In war injuries, it should be remembered that a latent tuberculosis, such as may exist in apparently healthy individuals, may have been present before the war, and this can only be decided by a roentgen examination. Similarly, the question of the traumatic origin of pulmonary tuberculosis can be best solved in this way.

The primary closure of a pulmonary trauma, except in complications, is effected by blood effusion into the shot canal. The fibrous matter of the coagulated blood is replaced by delicate connective tissue until a scar is formed. This is slightly visible in the roentgenogram, but in the case discussed by the author the projectile having become flattened, ploughed its way with its blunt end forward, through the lung, causing a canal which is distinctly recognizable by parallel striæ of thickened tissue.

The large number of diffuse tubercular foci, in conjunction with the deterioration of the general condition, points to the probability of the tuberculous extension being due to the stirring up of latent tuberculosis.

The following is the case of a soldier who had been injured by a shot a year ago.

Roentgen findings, Feb. 4, 1915. The lateral parts of the left diaphragm are adherent. Extensive callosities in the lateral parts of the

thorax. In the left lower lobe there is an irregularly formed revolver projectile. Parallel to the lateral thoracic wall, a shadow three fingers in width runs from the level of the fourth rib corresponding to the entry scar downward to the ninth rib. In this shadow which corresponds to a pleuritic thickening, there are numerous minute, sharply delineated though delicate tuberculous foci which do not brighten up at inspiration. The other areas of the left lung show only slight tubercular changes at the hilus in the form of isolated foci. There are several infiltrated lymph glands at the right hilus, also isolated tubercular small foci in the course of the vascular and bronchial ramifications in the right lower pulmonary field. At the border between the upper and middle lobes there is a nearly horizontal pleuritic band.

Thus there was a grave tubercular pleurisy on the left side with numerous fresh foci, emanating perhaps from an infected hematothorax caused by a projectile in the left lower lobe. There was also bilateral hilar tuberculosis. Old isolated tubercles were demonstrable in the right lower lobe.

Injuries to the pleura are usually of much greater importance for the course of a shot in the chest than an injury to the lungs. Thus, traumatic pleurisy is very often observed in the wake of a hematothorax. This is usually benign, provided there is no penetrating wound with injury of the external skin. Dissemination of existing tubercles may take place in injuries to the pleura as well as to the lungs. In both cases it is seen at the place of the trauma.

Non-traumatic pulmonary tuberculosis is very frequently seen radiating from the hilus to the neighboring parts of the lung, especially the upper lobe; in the traumatic form it is seen to diffuse from the seat of the lesion to the neighboring pulmonary and pleural tissues in the form of characteristic tubercular foci.

Although a coherent observation of the entire course was obviously impossible, it may be assumed that in both cases grave manifestations (hemoptysis, pleurisy, pneumonia) had resulted. Consequently, in both cases florid tuberculosis was the result of a trauma which had evidently hit upon a tubercular focus, causing dissemination of the pathological germs.

Unterricht[1] reports on a shot in the left lung, causing no tubercular sequelæ, although the right lung was tuberculous. This is intelligible, because the projectile did not hit the seat of tuberculosis.

Latent foci in the bronchial glands may be mobilized by injury, and enter into communication with the pulmonary tissue. This happened in the case of an officer who suffered a shot in the lung, crushing two ribs and involving large sections of the lungs and the hilus. The extension of the tuberculosis from the seat of the lesion and the crushed tubercular bronchial glands was plainly visible. But development of pulmonary tuberculosis as a sequel to thoracic injuries is comparatively rare. In the Franco-German war of 1870–71, among 348 cases of thoracic injuries, development of pulmonary tuberculosis was observed in 17, but as present methods of examination are superior to those of forty-five years ago, the statistical results will be more valuable.

The prognosis is serious. Repeated examinations should be made for weeks and months, even when there are no special complaints.

[1] *Münch. med. Wchnschr.*, 1915, No. 16.

STEIN, ALBERT E.: Papaverin in the Differential Diagnosis between Spasm and Stenosis of the Esophagus. (*Fortschr. a. d. Geb. d. Roentgenstr.*, Vol. 23, No. 4, Nov. 26, 1915, p. 366.)

Patient, male, 56 years old, had a pronounced nervous habitus and suffered from dysphagia, causing vomiting soon after the commencement of a meal. Roentgen examination showed the smooth passage of the bismuth paste down to the seventh or eighth thoracic vertebra where it was arrested with a jerk and gradually propelled toward the stomach in a very fine jet. Thus, there was an obstacle, but no indication as to its nature. Then, papaverin was administered. This preparation has the effect of decreasing the tension of the tonus of the smooth musculature, especially in gastro-intestinal affections. In the present case, fifteen minutes after the subcutaneous injection of 0.03 gram of papaverin, the roentgen examination showed the smooth passage of the paste, all obstacles being removed. Consequently there was neither an organic constriction nor a diverticulum, but simply a spastic, nervous, or functional affection.

Papaverin was then used therapeutically and led to the permanent relief of the complaint.

HESSEL, J. H.: Roentgen Examination of Stenosis of the Esophagus. (*Fortschr.*, Vol. 23, No. 4, Nov. 26, 1915, p. 337.)

This is a description of an esophageal carcinoma which was photographed after the method explained by the author to the Roentgen Congress of 1914. The sausage casing was introduced, filled with bismuth paste and drawn into the stenosis under the control of the screen, so that the stenosis was about in the centre of the sausage. The picture did not show the dilatation above the stenosis. The stenosis itself was visible for its entire length, but all the cavities were not filled. Below the stenosis, the normal smooth-walled esophagus could be seen as it received the pulsation of the heart. Another picture was taken after the patient, with the bismuth-filled sausage in position, had swallowed a further quantity of thick bismuth paste. Here the dilatation above the stenosis could be well recognized, the longitudinal extension of the stenosis, all the excavations and protrusions and the lower normal part of the esophagus. This is such a characteristic picture of an organic stenosis that it at once removes all the difficulties of a differential diagnosis.

BERNS, WILHELM: Roentgen Therapy in Pulmonary Tuberculosis. (*Fortschr. a. d. Geb. d. Roentgenstr.*, Vol. 23, No. 4, Nov. 26, 1915, p. 368.)

Berns, who is resident physician at the Sanitarium Birkenhof, publishes the result of the therapeutic application of roentgen rays in thirty tuberculous patients. The Veifa apparatus was used exclusively, very hard rays (not less than 8–10 Benoist) with gas regeneration and intense cooling devices, being administered in doses of 30x (Kienboeck) or over, at a time. The filter was 3–4 mm., the focus-skin distance about 20 cm., the size of the area at first 20, later 50 cm. sq. Treatment took place twice or three times a week on the average, the single doses amounting to 15–20x, applied either to one or two places, in the beginning of the treatment over the pathological foci and later over other parts of the lungs. According to the conditions of the patients, certain intervals were observed. In order to state an average figure, it may be said that in 100 days from 18 to 26 treatments were given, the total doses varying from 250 to 500x. A complete treatment lasted from three and one-half to four and one-half months, the total average doses reaching variable figures, in one case 1000x.

The thirty patients described are divided into three groups.

The first group comprises 14 cases in which febrile or subfebrile temperatures were gradually converted to normal. The second group comprises 9 cases which showed normal temperature at the beginning and in the course of the treatment. In some of these, even normal temperature was influenced by the effect of the rays. In the third group of 7 cases, the rays had no effect upon the temperature.

The total result was specific freedom from fever in 18 cases.

The remainder of the article is devoted to the consideration of the theories of the cause of this influence of the *x*-rays. The author concludes that this new method of treatment will never be able to take the place of the present method (diet, climate, exercise, rest, sanitarium treatment and nursing), but thinks that sanitaria are the proper places for combining the old methods with the new.

VON HERFF, OTTO: Protection from Radium Rays. (*Fortschr. a. d. Geb. d. Roentgenstr.*, Vol. 23, No. 4, Nov. 26, 1914, p. 379.)

Rubber gloves offer practically no protection. Two fundamental rules should be observed: (1) Radium capsules should be touched with the fingers as little as possible; (2) All manipulations should be made as far away from the capsules as possible.

The author describes in detail the methods observed at the Woman's Hospital at Basle. The principal items are the following:

The secondary filter which consists of brass is changed as rarely as possible—really only when the radium happens to be out of use. The inner silver jacket is caught with forceps. The radium carriers are caught with specially constructed forceps. The capsules have a silver ring by which they are fastened to a silver (preferably gold) chain 70 cm. long. At one end of the chain there is a snap hook secured by a screw. (Springs wear out too soon.) At a distance of 30 cm. from this end there is a ring. The snap hook is conducted through the ring of the jacket by means of a long forceps and fastened to the chain ring. In this way the fingers remain at a distance from the ra-

dium salt. At the other end of the chain, there is a second ring by which the chain may be attached to a belt during the application, so arranged that irresponsible or malicious persons may not easily remove it. This is done by means of a safety pin and a safety lock which prevents opening of the pin. (Made by Schaerer & Co., Berne.) The chain and capsules are cleaned in a bactericidal solution (aniodol). The chain is detached and sterilized in boiling water. The capsules are put into spirits of tetrachlorethylene soap. The capsule, secured by forceps, is thoroughly brushed with a specially shaped hard brush and placed back into the spirits of soap. The chain, having been boiled, is refastened to the capsule and placed in the aniodol solution ready for use.

Von Jagic, N.: Pathogenesis and Symptomatology of Chlorosis. (*Medizinische Klinik*, 1915, No. 3. Ref.: *Fortschr. a. d. Geb. d. Roentgenstr.*, Vol. 23, No. 4, Nov. 26, 1915, p. 386.)

The roentgen examination in pronounced chlorosis shows rather characteristic elevation of the diaphragm which may be regarded as a sign of degeneration due to superficial respiration and infantile costal position. Descent of the diaphragm with pendulum position of the heart and splanchnoptosis seem to be a rare occurrence in chlorosis. The narrowness of the aorta is not of diagnostic importance, being merely a sign of a generally hypoplastic constitution.

Seelig, A.: On Hematuria. (*Medizinische Klinik*, 1915, No. 5. Ref.: *Fortschr. a. d. Geb. d. Roentgenstr.*, Vol. 23, No. 4, Nov. 26, 1915, p. 387.)

Negative roentgenograms in renal tuberculosis prove nothing. Positive roentgenograms may lead to errors, as calcified tubercles furnish pictures quite similar to renal calculi.

Holmes, G. W.: Gastric Roentgenoscopy. (*Boston Med. and Surg. Jour.*, April 13, 1916, p. 581.)

The method discussed in the report has been employed at the Massachsuetts General Hospital for the past two years. Results obtained by it are believed to be as good at least as those obtained by more expensive methods.

During the year 1914, 730 roentgenoscopic examinations of the gastro-intestinal tract were made. Of these, 209 show evidence of organic disease of the stomach or duodenum; 144 were operated upon and the findings proven or corrected.

A diagnosis of duodenal ulcer or a question of duodenal ulcer was made sixty-five times. Of these, 34 were operated upon and an ulcer found. Seven were operated upon and no ulcer found. The remainder either refused operation, or were treated medically.

Of the cases where operation failed to reveal an ulcer, three were adhesions, two were chronic appendix and two negative. In only one of these cases was the duodenum opened. There were four cases in which an ulcer was found which was not located by the roentgen examination. Of these, one was thought to be a gastric ulcer, one was adhesions, probably from a healed ulcer, in one the examination was not complete, and one was a small bleeding ulcer which was not found until the duodenum was opened.

While irregularity in the filling of the duodenal cap is probably the most constant finding in duodenal ulcer, occurring in 31 of the 34 cases in which an ulcer was found at operation, increase in the depth and vigor of the peristaltic wave is also quite constant, it being present in 27 cases. Its absence in the presence of an atypical deformed duodenal bulb is, therefore, of great help in forming correct conclusions.

Six-hour gastric stasis was present in 23 of the 34 cases, a fairly large percentage (73%).

Gastric ulcer was suspected or diagnosed 47 times during the year. Of these, 18 were operated on and found to be ulcer. Three were operated on and no ulcer found in the stomach, but the stomach was not opened. The remaining 26 were not proven. In no case was an ulcer found where a lesion had not been demonstrated.

In the three cases in which an ulcer of the stomach was not found at operation, in one the deformity was due to adhesions, and one showed no pathology. The error was probably due to spasm, or a small ulcer may have been present, as the stomach was not opened. In one case, an ulcer on the lesser curvature involving the pylorus, with much dilatation of the stomach, was thought to be a duodenal ulcer.

Of the 18 cases operated on and proven to be gastric ulcer, in 10 the findings were sufficiently definite to make a positive diagnosis of ulcer. In eight the lesion was said to be probable ulcer, but malignant disease was not ruled out. All showed some irregularity in filling. Seventeen showed six-hour stasis, nine showed lack of tone, and nine showed increased peristalsis. The nine cases where there was marked obstruction with dilatation and atony show sluggish or absent peristalsis.

The roentgen findings suggested malignant disease of the stomach in 97 cases examined. Of these, 28 were operated upon and found to be malignant. Five were operated upon and no evidence of malignant disease of the stomach found. Of the five negative cases the findings at operation were malignant disease of the gall bladder in one, one was adhesions, and in three the findings were negative. One case of malignant disease was found where no lesion was demonstrated, although the fluoroscopic findings were suggestive in this case. In malignant disease, plates are of considerable additional value as they may bring out the mottled or finger-print appearance.

While there was no evidence to prove that early cases were missed, there were very few in which a positive diagnosis was made where the growth was not too far advanced to be cured by operation. It is the author's belief that these cases do not have sufficient symptoms to make them seek help until the lesion has become inoperable.

The opaque meal consists of 2½ oz. of barium sulphate in 8 oz. of potato starch gruel. Care is taken to have the stomach empty at the time of examination and to have the patient fast during the six-hour period. Observations were made during the taking of the meal, in the upright position, following when necessary by the prone, supine and oblique positions, the right oblique position with the patient prone was found very satisfactory in bringing out the duodenal bulb. Atropine was used where spasm was suspected. Six and twenty-four-hour observations were made in all cases.

CASE, JAMES T.: Fluoroscopy of the Stomach. Medical Clinics of Chicago. July, 1916, Vol. II, No. 1, p. 199.

Dr. Case's contribution is a stenographic report of an *x*-ray clinic at St. Luke's Hospital.

After a discussion of modern fluoroscopic apparatus and the relative value of plate and screen methods of studying the alimentary tract, the author proceeds to a detailed description of the technic of examination of the esophagus, stomach and duodenum. Great stress is laid upon the proper preparation of the eyes and their adequate protection.

Attention is drawn to the liability of error in concluding that adhesions involve the hepatoduodenal regions because the stomach occupies an unusually transverse position. It is true such a position suggests hepato-fixation, but no one would dare to make a diagnosis from this *appearance* alone. Satisfactory palpation must be practiced. One must determine by actual palpation under the screen that it is impossible to pull the pyloric end of the stomach away from its right-sided position under the liver, before concluding that such binding adhesions do exist. In very heavy individuals, especially those tending to obesity, proper manipulation to determine this question of adhesions is often impossible, and then the question must be left unanswered. Without intelligent palpation carried on under fluoroscopic guidance one can hardly hope successfully to detect binding adhesions of the cecum, appendix, terminal ileum, or any other portion of the bowel.

Much has been written and said concerning the relative value of the plate and screen methods. Those fully acquainted with the details of technic of European roentgenologists realize that *x*-ray work as practiced on the Continent, especially in relation to internal medicine, is essentially fluoroscopic. The making of plates and prints is a matter of very minor consequence in the average European roentgen examination department. In America, on the contrary, the examinations have been, from the first, roentgenographic rather than roentgenoscopic.

In the study of fractures and in the recognition and localization of calculi and foreign bodies, roentgenography is not only the more reliable, but it also affords the necessary permanent records of the case. In the study of diseases of the thorax the plate records are desirable, and in the study of pulmonary tuberculosis they are absolutely necessary for interpretation and comparison with other clinical findings.

In the study of the alimentary tract, however, fluoroscopy is the method of choice or,

rather, we may say, the method which gives us by far the greater yield of valuable information concerning the case. The roentgenogram furnishes a representation of static conditions, the shape (at the moment) and the position; but, of far greater importance in the majority of cases, roentgenoscopy furnishes data concerning mobility, motility, coincidence of pressure pain points with filling defects, spastic manifestations in the stomach and other questions relating to function, which, by roentgenograms alone, either cannot be shown at all, or only with difficulty and at considerable expense.

Directions are given for palpation under the fluorescent screen by using the wooden spoon instead of the hand, even though protected by a glove. The roentgen appearance of the normal stomach and duodenum is then described in detail.

BROPHY, TRUMAN W.: Roentgenography and Dental Pathology. Medical Clinics of Chicago, July, 1916, Vol. II, No. 1, p. 143.

The author emphasizes that properly made and correctly interpreted roentgenograms of the teeth are of inestimable value in making diagnoses. It does not do to accept a roentgenogram unless it is absolutely clear and shows the parts in every detail. On the other hand, even the clearest roentgenogram is often misinterpreted.

On February 1, 1916, Dr. Brophy, before the Odontological Society of Chicago, spoke as follows:

"I have lately been impressed with the condition known as darkened area in roentgen photographs not only from the work that I have had done, but on account of reviewing the work of others. It was not until probably four years ago that I was impressed with the mistakes I had made in reading *x*-ray pictures, and that was brought about in this way (I point this out because I am satisfied that a great many have made and perhaps are making the same mistakes that I did): At that time whenever I saw a darkened area around the apex of a root of a tooth I assumed that it meant the presence of an abscess, but when I made *x*-ray pictures of fracture of the mandible I found a well-defined line of fracture, for which I made use of splints, readjusted the fragments, restored the normal occlusion of the teeth, waited six or eight weeks, and then made another skiagraph of the same bone at the same place; I found exactly the same appearance that I found when I had the first skiagraph made, and concluded, before I learned better, that a fracture still existed. The newly formed bone was not sufficiently dense in structure, not sufficiently ossified to present the same appearance that the normal older bone did, so I was misled. Leaving the splints on for five or six weeks longer and again making a roentgen photograph, I still found a well-defined line at the fracture; but feeling satisfied that the bone was united, I removed the splints and found that the bone had firmly united and was all right, yet at that time it showed exactly the same condition that it did when the first skiagraph was made. This led me to believe that I had been making mistakes regarding the darkened areas at the ends of the roots of teeth.

"Now I am convinced that these darkened areas we see on the plate are by no means evidence of an abscess. They are evidence, however, that an abscess once existed, that the bone was destroyed or absorbed by pressure, and that perhaps there was infection of the organic matter of the bone to such an extent that some of the bone itself became disintegrated. In some instances we all know a great deal of the bone will become disintegrated and large cavities will be left at the ends of the roots of the teeth; but these large cavities, everything being done to exclude further infection by having the root well defined, will be filled by the new bone.

"In this connection I would like to state that at the meeting of the Clinical Congress of Surgeons of North America, held in Boston last fall, Dr. M. L. Rhein read a paper on this subject and presented, by means of the stereopticon, some plates showing teeth, the roots of which were not well filled, with rather large areas of destruction at their apices. Then he showed the same teeth, skiagraphs of which were made two years later. He had removed the fillings from the roots of those teeth and refilled them, following which there was sclerosis, the bone was well developed, completely surrounding the end of the roots, and showing as complete an alveolus as surrounded any of the teeth with living pulps. The darkened cavities were filled with new bone."

CASE, J. T.: The Roentgen Treatment of Uterine Carcinoma. (*Surg., Gynec. and Obst.*, April, 1916, Vol. XXII, 429.)

Assuming that there is no disagreement as to the successful application of the roentgen method in the treatment of superficial cervical epithelioma, this paper is confined to an inquiry into the value of present-day deep roentgentherapy in uterine cancer which has advanced beyond the stage of superficial epithelioma. By newer methods, the author refers to more powerful apparatus, improved filtration, improved technic of irradiation, crossfire, near focus-skin distance, etc., and the use of the Coolidge tube. These various developments have rendered possible the effective employment of doses aggregating at least one hundred times the maximum dose considered safe ten years ago. Warning is given, however, that this increase in the value of the method has been accompanied by a corresponding increase in the danger attending its use. Greater skill and judgment are now required. Insufficient irradiation is likely to produce more active growth through irritation, instead of the intended destruction. Without adequate filtration the treatment is worse than useless.

Emphasis is laid upon the growing value of roentgentherapy as a palliative treatment. Some clinical cures are reported, but a sufficient percentage of apparent cures lasting three or more years has not been obtained; so that at the present time we are not justified in claiming for the *x*-ray or radium a permanent curative value. Nevertheless, the destruction of cancer-cells in the uterus has been demonstrated histologically by various reliable investigators. There is a tendency for connective-tissue newgrowth to replace the destroyed carcinomatous cells. Typical cases are cited, with the histological findings. Since the possibility of cure has thus been demonstrated, we must not be too discouraged, although our experiences to date do not include any permanent cures. The question of permanency of cure cannot be known until after the lapse of eight or ten years. As yet we are not justified in substituting roentgentherapy for operation in any operable cases.

Post-operative roentgenization is urged in all cases of malignancy. This treatment should be applied as soon after the operation as possible and as thoroughly as though the disease were still present in its entirety, the patient's sole prospect of cure resting on radium and roentgentherapy.

CROSS, CHAS.: Golfer's Foot. (*Med. Rec., New York*, May 20, 1916, Vol. LXXXIX, No. 21, p. 896.)

The author feels that, in view of the widespread interest being manifested in golf in this country, it will be timely to consider an ailment which may afflict anyone who plays that game.

Golfer's foot is a term the author has applied to an acute condition due to distortion of the foot as a result of broken arch in the anterior metatarsal curved area. The affliction is very easily acquired, it is often neglected, and sometimes becomes very troublesome. To add to the aforementioned discomfort, golfer's foot makes the player fretful and it interferes with play. If neglected, the condition is liable to lead to a chain of efficiency-reducing ailments, the cause of which may be entirely overlooked.

When playing golf the anterior portion of the left foot, in right-handed players, and vice versa in left-handed players, is brought into unusual service. The body weight comes over on the anterior portion of the left foot when making a right-handed drive. Some players turn on the inside of the foot, resting the weight on the anterior portion, on the fulcrum of the great toe. Players of this class are very liable to develop a large callus on the inner side of the great toe about opposite to the bed of the nail.

As the drive is made the weight of the body is brought back upon the foot that has been elevated in the upswing, and it is brought back with great force. A great part of the force is distributed to the outer half of the anterior portion of the foot, or to the portion of the ossa fulcra made up of the heads of the metatarsal bones of the third, fourth and fifth toes. The third and fourth metatarsals are generally the least used part of a foot and consequently, like the ring finger in the hand, they usually form the weakest portion. They are the first to give way when under strain.

The condition found in golfer's foot is not of necessity confined to golf players. It is a very common distortion and may occur in any foot that is overused. On physical examination one may find the afflicted foot slightly wider over the ball of the foot. The patient knows there

is a difference. Over the heads of the metatarsals mentioned there may be slight evidence of swelling, or a little more prominence of the extensor tendons of the toes. By means of the *x*-ray examination the author claims to be able to show distortion of the heads of the third and fourth metatarsal bones.

Golfer's foot is to be differentiated from chronic anterior broken-arch or chronic metatarsalgia, or Morton's toe.

BAUCH, SOLOMON: Syphilis of the Lung; Report of Two Cases. (*Med. Rec., New York*, May 20, 1916, Vol. LXXXIX, No. 21, p. 906.)

Two cases are reported. The first, a male, age fifty-one, presented amphoric breathing; marked dullness over the right lung, especially at the apex and base; amphoric breathing in the upper and lower lobes; pleuritic râles over the middle and lower lobes; cavities in the upper and lower lobes.

Three years ago the patient was confined to bed with fever, cough, and pain all over his chest for about one week, from which he made an uneventful recovery. About a year ago he began to cough, lost weight, and complained of general weakness, night sweats, and pain in the right chest. These symptoms became so severe that he was compelled to give up his work. While he remained at home patient slightly improved. He never had hemoptysis.

X-ray examination showed marked dense bands of fibrous tissue all over the right side. Hilus glands enlarged on both sides. Left side clear all through. There were a great number of variously sized cavities and marked fibrous and pleural adhesions in the upper half. Pneumothorax in axillary portion of the upper half. Differentiation very difficult, due to the marked adhesive and fibroid process. The lower half showed a dense peribronchial infiltration, with marked density at axillary portion of the base, and with numerous enlarged bronchi. The quiet, evenly dense shadow at the lower axilla might be due to thickened pleura. Left lung normal, except for the enlargement of the hilus gland. The mediastinum was displaced to the right. The diaphragm on the right side was high up and irregular. The ascending aorta was markedly widened.

Patient never had fever. Twenty-four examinations of the sputum for tubercle were negative, including antiformin test. Four Wassermann examinations gave ++++ each time. Guinea pig injection with sputum proved negative. Complement fixation, negative. Five injections of salvarsan, mercurial injections and iodide administration for one year gave no marked improvement either in the general or local conditions. The patient feels comfortably well, is usually without fever and no longer loses in weight.

The second patient, a man of twenty-eight, is somewhat similar. The diagnosis of syphilis of the lung rather than tuberculosis was based on the following facts: (1) the fact that the patient's lung condition remained the same, without the rapid destruction of lung tissue; (2) the fact that the patient's general condition was always stationary, without becoming emaciated; (3) the repeated negative sputum; (4) the repeated positive Wassermann. The patient had two children at a sanatorium, one of which developed interstitial keratitis. The child also gave a positive Wassermann at each of four tests.

The *x*-ray examination showed that the lung roots were fairly involved and the ascending aorta was dilated. This patient refused treatment.

The two cases reported above not only add material to the subject of syphilis of the lung, but they tend to stimulate the minds of those who have human interest at heart to investigate whether many more so-called cases of tuberculosis are not truly of syphilitic origin, and not to wait till gummatous ulcerations or excavations are found, when the antisyphilitic treatment does them little good. It would be advisable in the many cases in the sanatoria which show lung involvement and negative sputum, to take the blood for Wassermann, and, in case of doubt, to begin antisyphilitic treatment.

PFENDER, CHAS. A.: Indications for Surgery or Deep Roentgen Therapy for Myomata and Metropathies. (*Med. Rec., New York*, April 1, 1916, Vol. LXXXIX, No. 14, p. 596.)

It should be noted that the author is a roentgenologist. It might be this fact had some influence on his method of handling the question. He first describes the improvements in roentgentherapeutic methods, ending with the perfection of the Coolidge tube, and calls attention

to the results that are today being achieved that surpass the fondest hopes of the early pioneers in *x*-radiation.

In the light of our present knowledge we can safely say that roentgen therapy deserves consideration in all operable tumors for the reason that in many instances radiation offers an equally good or better prognosis than surgical procedure. Roentgenologists are agreed in every detail with the one exception of the number and sizes of areas treated at one series and possibly the size of the fee involved. A few employ very large areas, giving a total of only four erythema doses at one series, while others treat from eight to sixty areas at one series and probably collect proportionately.

The author uses crossfire in six to eight areas at one series, and repeats in three or four weeks. Treatment is given at the skin-focus distance of six or eight inches, with an equivalent spark gap of eight to ten inches, and from 24 to 30 ma.-minutes. The author filters through four millimeters of aluminum and a piece of sole leather.

The opponents of deep roentgen therapy in gynecology, for want of no better argument, raised the point that so many fibroids are found at operation to be sarcomata. They assume that had these patients been radiated they would have invariably died from the ravages of this disease. The masterful compilation by James Ragland Miller throws an entirely different light on the subject. The following table shows conclusively that in more than 10,000 cases of myomata which came to operation only less than two per cent. were sarcomata. In the next table you will observe that in more than 6,000 radical myomectomies the mortality rate was practically five per cent.

Occurrence of Sarcoma

	Myoma	*Sarcoma*	*Per cent.*
Compiled from 26 operators.	9750	192	1.96
Lewis.....	1518	22	1.4
Olshausen.....	6470	77	1.2

Radical Myomectomies

	No. of Cases	*Deaths*	*Per cent.*
Compiled from 22 operators.....	6646	324	4.87
Doederlein-Kroenig.....	1982	99	5.00

Not content with the presentation of facts as noted in the foregoing tables, Miller investigated the operative results of sarcoma in 180 cases and found that only 23 or 12.7 per cent. remained free from recurrence twelve months after operation. Roentgen radiation combined with surgery would have saved twice as many or more.

Operative Results of Sarcoma

	No. of Cases	*Died*	*Not Observed more than 12 months*	*Free from Recurrence 12 months after operation*
Compiled from 13 references and operators.....	180	81	76	23, or 12.7%

Miller also states that "since October 10, 1906, all myomata removed by operation in the Freiburg Frauenklinik have been carefully examined in the pathological institute under the control of Professor Aschoff. Up to February 7, 1911, among 249 myoma cases not a single sarcoma was found. Between February 7, 1911, and July 28, 1912, there appeared suddenly 5 sarcomata among 69 cases. It would be wrong to draw any conclusions from either series of cases."

In metrorrhagia at or near the menopause the author believes radiation is always indicated in climacteric and preclimacteric bleeding from the uterus. This should be preceded, if possible, by a microscopic examination of scrapings from the uterine mucosa in order to exclude a malignant degeneration of the mucosa.

In all cases of fibroids where the patient suffers from marked anemia or myocarditis or from renal disease or from any other disease that would endanger the life of the patient if subjected to surgical measures, deep roentgen therapy should be done. The one exception would be in cases where the size of the myoma caused dangerous pressure symptoms of equal gravity as an operation for possible relief. In all cases of fibroids where deep roentgen therapy fails to reduce the tumor or arrest the bleeding, the patient should be referred for operation.

Gould, E. W., and Le Wald, L. T.: Roentgenologic Findings in Chloroma. (*Arch. Pediat.*, June, 1916, Vol. XXXIII, No. 6, p. 417.)

Comparatively few cases have been reported of the disease called chloroma or green cancer. The most complete description of the disease was given by Dock and Warthin in their excel-

lent review of the literature on this subject. Chloroma is a condition arising from a hyperplasia of the parent cells of the leukocytes, especially in the red marrow of the bones. It also occurs in any of the leukoblastic tissues of the body, and we therefore find neoplasm-like formations in the spleen, liver, lymphatic glands, and, in fact, in almost all the tissues of the body.

The chief clinical features which characterize the disease are an exophthalmos, which is produced by a retrobulbar lymphoma; swellings of the temporal and occipital regions, due to the involvement of the cranial bones; enlargement of the spleen and lymphatic glands throughout the body, especially of the cervical region; and a severe and progressive anemia causing weakness, fever and emaciation.

Nearly all cases have shown an involvement of the bones of the skull, and it is this feature which gives rise to some of the most characteristic signs and symptoms of the disease. This hyperplasia undoubtedly begins in the marrow of the cranial bones, but soon involves the periosteum and the dura mater, forces the sutures apart, fills up the various foramina of the skull, and by pressure upon nerves which emerge from the brain through these openings may cause blindness, deafness, pain or other symptoms referable to the nerves involved.

The roentgen ray findings in the two cases of chloroma studied appear to be fairly characteristic, especially in regard to the proliferation of bone tissue in the skull producing a separation of the suture lines.

In the second case studied there are characteristic changes in the long bones. The process appears to be essentially a rarefaction and proliferation in the medullary cavities over a variable distance from the surface of the shaft. The absence of epiphyseal changes distinguishes the condition from infantile scorbutus and rachitis. The combination of the periosteal changes with the changes in the medullary cavity distinguishes the condition from a myelomatous lesion. The extent of the process distinguishes the condition from sarcoma. The changes in the medullary portion of the bone appear to be distinctly different from syphilis.

These findings are exactly in accord with the gross pathologic changes described by Warthin. As far as we have been able to ascertain these are the first cases in which the roentgen ray findings have been recorded.

HIRSCH, I. S.: Summary of the Roentgen Diagnosis of Cardiac Lesions. (*Am. Jour. Electrotherap. and Radiol.*, July, 1916, Vol. XXXIV, No. 7, p. 351.)

This article is an admirable summary of the methods and results of the roentgen examination of the heart and aorta.

A number of explanatory drawings, apparently modified from Groedel, are presented, and Groedel is quoted as authority for many of the statements.

The article has great teaching value and is well worth study. It is too lengthy for adequate abstract.

PFENDER, C. A.: Roentgen Therapy in Carcinoma. (*Interstate Med. Jour.*, May, 1916, Vol. XXIII, No. 5, p. 105.)

This is a well stated summary of the present status of roentgen therapy in carcinoma, in which the author quotes extensively from the work of Kienboeck, Czerny and others.

The article is well calculated to stimulate more careful and consistent use of the roentgen ray in carcinoma, and is well worthy of perusal.

BASSLER, A.: Some X-Ray Thoughts of 1915. (*Interstate Med. Jour.*, May, 1916, Vol. XXIII, No. 5, p. 105.)

The writer calls attention to the great value of the roentgen method of examination of the stomach and intestines and pays tribute to the contributions of the various American roentgenologists.

He regrets, however, that no considerable advance has been made in the roentgen examination of other tissues of the abdomen; that the liver, spleen, and even the kidneys are still comparatively dark to diagnosis by *x*-ray. He hopes that it will become possible to outline the gall bladder constantly, and suggests the possibility that some chemical substance may be found which, taken by mouth, will be resorbed into the portal circulation and carried into the bile-ducts, thus having the effect of casting a shadow which would contrast the bile sac with the surrounding tissue.

There are a number of conditions not possible of diagnosis by *x*-ray. It is possible that in cases that are essentially chronic, *x*-ray examination will point out what surgery is indicated, rather than whether it is indicated.

Bassler decries the general statement that

"history is 50 per cent., the *x*-ray 40 per cent. and the laboratory 10 per cent. of gastro-intestinal diagnosis" as being worthless and misleading. It is probably true from a strictly surgical standpoint, but a large proportion of all gastro-intestinal cases are not conditions in which surgery could, or ever will, be helpful.

One statement by Bassler is somewhat difficult to understand, inasmuch as he advises the *x*-ray man not to do exactly what he himself has done. He criticises some roentgenologists who also do history taking, and others who do laboratory work in addition to *x*-ray work, claiming that these are mistakes "from the standpoint of a normal and proper position of roentgenologists, because they dilute the strength of their positions as specialists, and there is danger of some sides of a multisided work suffering. It takes years to make a good clinician, years longer to make a good gastro-enterologist, years to make a good pathologist and physiological chemist, not to speak of the years one must spend in a proper *x*-ray experience. Unless a number of star men combine each of these sides in an organization, each having his due importance of position, it is better for the *x*-ray man to do just his kind of work and let the clinical, laboratory and surgical sides for others to deduce his value from, and for them to go to him for what he can supply."

Very properly Bassler gives Crane credit for prior use of the term "drain trap" stomach, and urges that in honor to a man who is a pioneer in roentgenology and a most conscientious and capable worker, Crane should have the credit for it. On the whole, however, it would be better that terms like the "water-trap stomach of Satterlee and Le Wald" or "drain-trap stomach of Crane" should cease in literature.

Bassler closes his thoughts with the remark that there are a number of specialists doing *x*-ray work in connection with their office practices. "Some of these are doing a good quality and deserve praise. Most of them, however, are doing it in a perfunctory or limited manner, and the results plainly show that they are not doing justice to what this means of examination can give when it is properly and thoroughly done and a competent knowledge of interpretation is on hand. Some of these will undoubtedly qualify as time and experience go on. But to those who, after considerable experience, have not or cannot for any reason, it would be fairer to patients (this means of examination), and to roentgenologists, that they discontinue and refer the work to other hands. There is much more to roentgenology than apparatus and technic. There is the man with his experience behind these, his enthusiasm, the time he gives to it, and so on. Roentgenologists make mistakes in diagnoses. Who in medicine does not? But these mistakes in proportion are fewer and less important than those made by clinicians who do a poor quality of *x*-ray work and are depending upon it."

JACHES, L.: Calcified Fibroma of the Forearm. (*Am. Atlas Stereoroentgenol.*, June, 1916, Vol. I, No. 2, p. 60.)

In this very interesting case there was an oval, hard, tender mass on the under side of the left forearm near the upper end of the ulna. The veins over the mass were distended to a marked degree, the skin was free and movable, and motion at the elbow was free, although the tumor measured six inches by three inches. The roentgenogram showed an oval mass almost completely calcified, measuring five and one-quarter inches by two inches, apparently arising from a small place on the inner surface of the ulna just below the coronoid.

At operation for removal of the tumor mass, it was found overlying the ulna, apparently attached to the deep fascia, but not attached to the bone.

Microscopical examination showed a calcified fibroma.

METCALF, JAMES: A Prepared Barium Meal. (*Brit. Med. Jour.*, July 8, 1916, No. 2897, p. 42.)

Nearly eighteen months ago a committee appointed by the Electro-Therapeutic Section of the Royal Society of Medicine considered the question of a standard opaque meal for *x*-ray examinations of the stomach and intestines. It was considered that a meal of two ounces of bismuth oxychloride, or two ounces of barium sulphate, made up to about half a pint with bread and milk, or porridge, was about the proper amount to administer. Dr. Morton added a note to the report that the opacity of bismuth oxychloride was about double that of an equal weight of the barium sulphate.

In the discussion of this subject Metcalf advised that a meal should be recommended of

pleasanter composition than the one mentioned. The grittiness of the barium salt, the unpleasantness of the mixture, and the difficulty in hospitals of getting it well made, militated against its usefulness. He has formulated a meal which he thinks overcomes many difficulties in connection with this form of examination. It is made up of 75 per cent. of pure barium sulphate with 25 per cent. of a pabulum of cocoa, arrowroot, desiccated milk, etc. The whole is ground together into an impalpable powder in such a way that there is no grittiness and great evenness in distribution.

All that is required in the preparation of this meal is to rub it up with a little cold water into a paste, in a small pan over a spirit lamp, add some more water and bring it to the boil, when, on allowing it to cool for a few minutes, it can be administered. It is pleasant to take, can always be prepared in the *x*-ray room without each time troubling nurses to have the material weighed out in a dispensary, find milk, etc., and on account of the thorough admixture of the material the definition of any irregularities in the contour of the hollow viscera are more readily discovered. It can also be used for rectal examinations through a long tube.

REU, LEONARD: A Case of Tubercular Kidney Complicated with Multiple Calculi. (*Interstate Med. Jour.*, May, 1916, Vol. XXIII, No. 5, p. 122.)

This is a very interesting case in which the findings of the genito-urinary surgeon and the roentgenologist together were sufficient to make a diagnosis which, by either method alone, would not have been correct. The diagnosis was confirmed at operation.

GRIER, G. W.: The Roentgen Treatment of Uterine Fibromata. (*Interstate Med. Jour.*, May, 1916, Vol. XXIII, No. 5, p. 118.)

In this article Grier sums up briefly the progress in deep roentgentherapy and goes into a discussion of indications and dosages.

The author is convinced that it is not necessary to produce the menopause to gain the desired results; also that there is no technical difficulty in producing artificial menopause in a young woman. He cites a case in which the menopause was produced in a patient of thirty-six years after two sittings of six treatments each, the entire dose being 250 X (Kienboeck) units.

He is inclined to believe that the dose commonly given is probably greater than is necessary to produce the required results. Mention is made of the new technic employed by Kroenig and Gauss, in which the required dose is given at one sitting through one area only. A much denser filter (copper) than the ordinary one is used. The necessary dosage is given in one sitting, three hours long. The advisability of subjecting the average patient to such an ordeal as three hours of continuous roentgen irradiation appears to the author as questionable. Not only is the physical strain great, but there are also the extreme nausea and prostration which usually follow such intense irradiation.